SITE: SCRDI Bluff
BREAK: 5.9
OTHER: VI

RECORD OF DECISION
REMEDIAL ALTERNATIVE SELECTION

SCRDI BLUFF ROAD SITE
COLUMBIA, RICHLAND COUNTY
SOUTH CAROLINA

PREPARED BY:

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION IV
ATLANTA, GEORGIA

10638005

SUMMARY OF REMEDIAL ALTERNATIVE SELECTION

SCRDI BLUFF ROAD SITE
COLUMBIA, RICHLAND COUNTY
SOUTH CAROLINA

PREPARED BY:

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION IV
ATLANTA, GEORGIA

DECLARATION FOR THE RECORD OF DECISION

SITE NAME AND LOCATION

SCRDI Bluff Road Site
Columbia, Richland County, South Carolina

STATEMENT OF BASIS AND PURPOSE

This decision document represents the selected remedial action for this site chosen in accordance with CERCLA, as amended by SARA, and to the extent practicable, the National Contingency Plan. This decision is based on information contained in the administrative record file for this site.

The State of South Carolina concurs on the selected remedy.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF THE SELECTED REMEDY

This remedy addresses the source of contamination to groundwater (contaminated soil) and the contaminated groundwater present at the site.

The major components of the selected remedy include:

GROUNDWATER

- Extraction of contaminated groundwater
- On-site treatment of extracted groundwater
  - Pretreatment for metals removal
  - Air stripping
  - Liquid phase granular activated carbon system
  - Vapor phase activated carbon system (emissions control)
- Discharge of treated groundwater via reinjection
- Groundwater remediation will be performed until all contaminated water meets the cleanup goals specified in the attached Summary of Alternative Selection

SOIL

- Installation of a network of air withdrawal (or vacuum) wells in the unsaturated zone
- Construction of a pump and manifold system of PVC pipes used for applying a vacuum on the air wells to remove the organic compounds from soil

STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, attains Federal and State requirements that are applicable or relevant and appropriate, and is cost-effective. This remedy satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principle element. Finally, it is determined that this remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable. Because this remedy will not result in hazardous substances remaining on-site above health based levels, the five-year facility review will not apply to this action.

Joe R. Franzmathes
Greer C. Tidwell
Regional Administer

Date SEP 12 1990

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FIGURES AND TABLES

1.0 Introduction

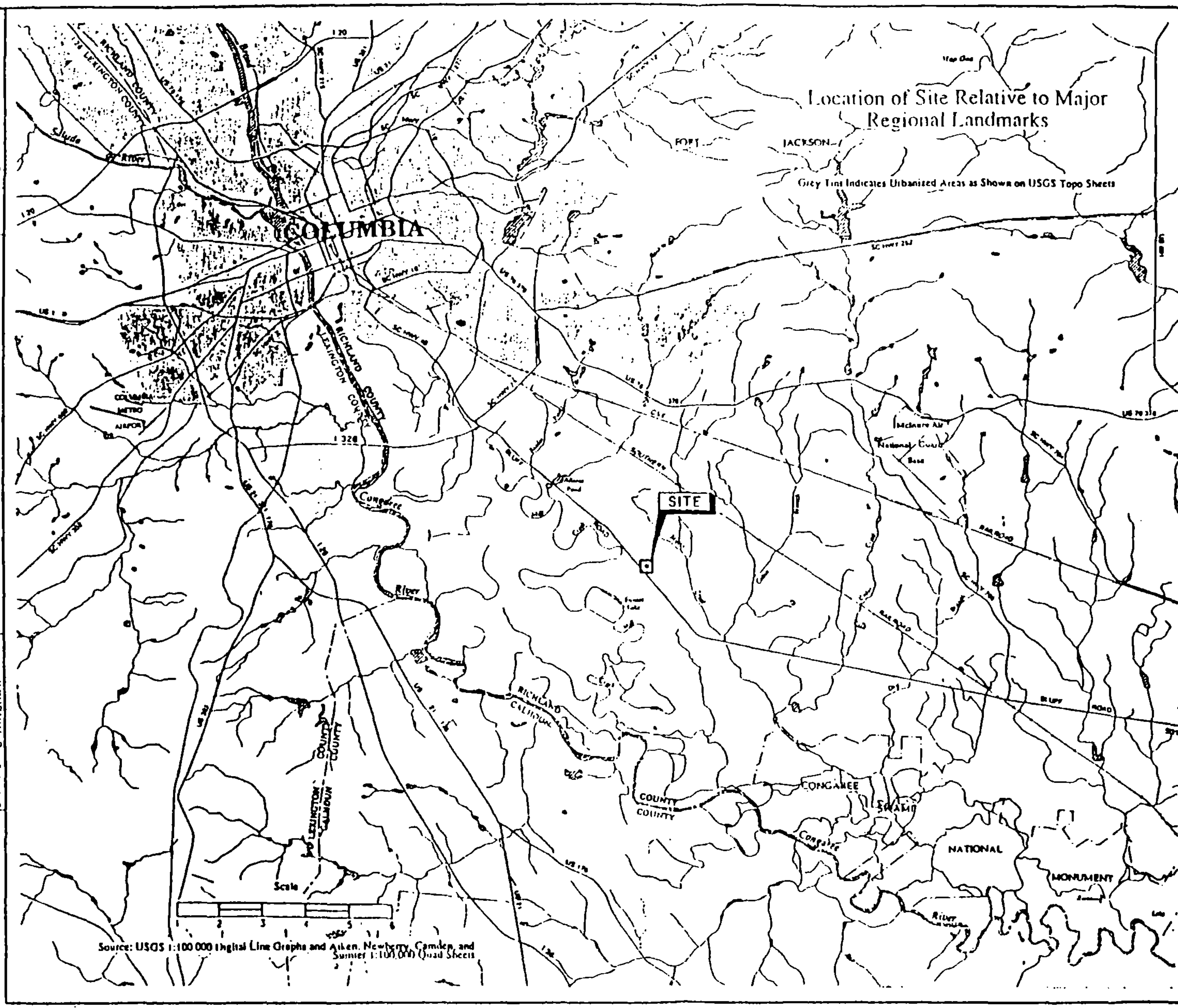
1.1 Site Location and Description

The SCRDI Bluff Road Site is a four acre parcel of land located in Richland County, South Carolina and is approximately 10 miles south of the City of Columbia on the north side of State Highway 48. (Figure 1) The site is a rectangular parcel of land measuring 133 feet of frontage on Bluff Road (Highway 48), and extending back from the road approximately 1,300 feet. (Figure 2) The site is relatively level with ground elevation varying from approximately 139 feet near the highway to 134 feet above mean sea level at the rear of the property. The front portion of the site, extending to approximately 600 feet from the road, is cleared and has been used for various industrial and commercial purposes. The back portion of the site, encompassing one half of the area, is heavily wooded. Surrounding and adjacent properties are wooded and rural. The nearest residences are approximately a mile away.

The soils identified in the project by the Richland County Soil Survey include loams, which are mixtures of sand, silt, and clay. The specific soil types present in the vicinity of the site are Orangeburg loamy sand, Persanti very fine sand loams, Smithboro loam, and Cantry loam. A low permeability surface clay layer was predominant in areas adjacent to the site.

The local hydrogeology pertinent to the site is defined by a surficial aquifer and a deep aquifer with the two formations separated by a clay aquitard. The shallow aquifer typically extends to a depth of 45 to 50 feet and is composed primarily of sands which range from coarse and well sorted to silty and poorly sorted. This aquifer has been classified as a potable aquifer by the State of South Carolina. The ground water table in the shallow aquifer generally lies 10 to 15 feet below ground surface based on the three rounds of ground water level measurements taken. The deep aquifer is separated from the shallow aquifer by a clay and silt unit which ranges in thickness from 1.5 to 25 feet. This partial confining layer is thinnest upgradient of the site and thickens to the south and west. The State still has a question as to whether or not the clay layer is continuous over the area of the site. This will be resolved during the Remedial Design development. The lithology of the deep aquifer is similar to that of the shallow aquifer, though clay-rich layers are more common. Both the clay aquitard and the deep aquifer are thought to be units in the Black Creek Formation.

Most of the nearby property and rear portions of the site have been classified by the Corps of Engineers as wetlands. A Westinghouse Nucleur fuel rod manufactoring plant is located across Bluff Road. Current use of the Site and nearby properties is rural and wooded (with the exception of the Westinghouse plant). Future use of the property is likely to be light industrial development.

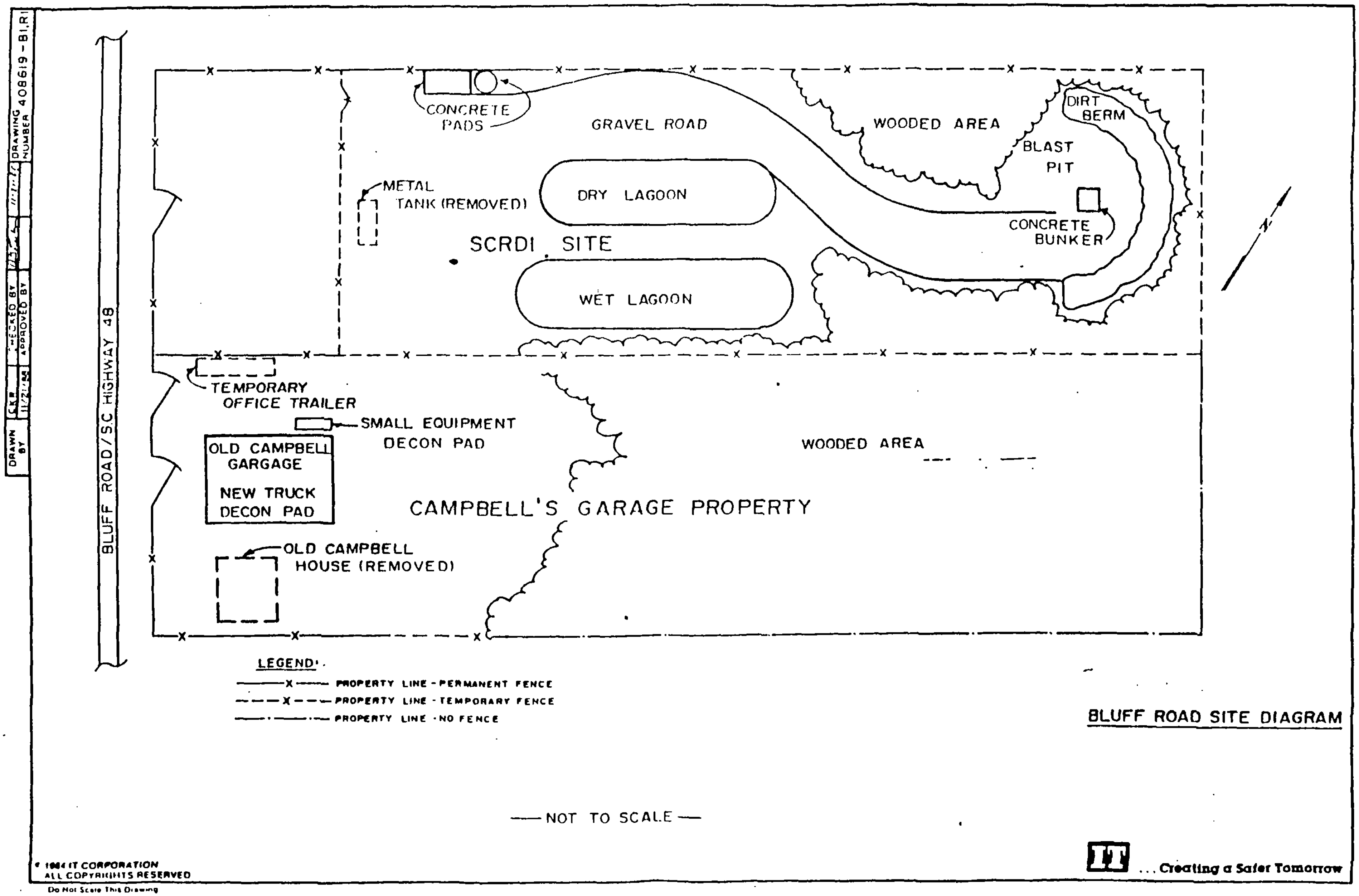


DRAWING NO 408619-B-C15
PROJECT NO 408619
INITIATOR: D. ERIKSON
PROJ MGR: D. ERIKSON
DATE LAST REV.:
DRAWN BY:
STARTING DATE: 7-19-89
DRAWN BY: C. HINSHAW
BRUNING 72425

FIGURE 1
BLUFF ROAD SITE
VICINITY LOCATION

BLUFF ROAD
COLUMBIA, SOUTH CAROLINA

INTERNATIONAL TECHNOLOGY CORPORATION



DRAWING NUMBER 408619-B1,R1
DRAWN BY
CKB 11/21/84
CHECKED BY
APPROVED BY
BLUFF ROAD/SC HIGHWAY 48
CONCRETE PADS
GRAVEL ROAD
WOODED AREA
DIRT BERM
BLAST PIT
METAL TANK (REMOVED)
DRY LAGOON
CONCRETE BUNKER
SCRDI SITE
WET LAGOON
TEMPORARY OFFICE TRAILER
SMALL EQUIPMENT DECON PAD
OLD CAMPBELL GARGAGE
NEW TRUCK DECON PAD
WOODED AREA
CAMPBELL'S GARAGE PROPERTY
OLD CAMPBELL HOUSE (REMOVED)
LEGEND:
PROPERTY LINE - PERMANENT FENCE
PROPERTY LINE - TEMPORARY FENCE
PROPERTY LINE - NO FENCE
BLUFF ROAD SITE DIAGRAM
NOT TO SCALE
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Do Not Scale This Drawing
IT ... Creating a Safer Tomorrow

FIGURE 2

1.2 Site History

The first reported use of the site was as an acetylene gas manufacturing facility. Specific dates and other details regarding the facility operations are not available. However, two lagoons were constructed at the north end of the cleared area of the site to support acetylene manufacturing.

In 1975, the site became a marshalling center for Columbia Organic Chemical Company. Columbia Organic Chemical Company funded the operations of Bluff Road which used the site beginning in 1976 to store, recycle, and dispose of chemical wastes. The site was closed in 1982 after a ground water investigation conducted by the South Carolina Department of Health and Environmental Control (SCDHEC) and EPA revealed the presence of site contamination of soils and groundwater.

A surficial cleanup of the site was performed in 1982 and 1983. Over 7,500 drums containing various chemicals were removed from the site for disposal. Visibly contaminated soil and all above ground structures were removed from the site. Clean fill and gravel were placed on the site to fill in excavations and provide clean roads. The two lagoons and an above ground tank containing approximately 100 gallons of sludge were left on-site. This above ground tank was removed in 1989 as part of the RI/FS at the site.

2.0 Enforcement Analysis

The Bluff Road Site is ranked 83rd on the National Priorities List by the U. S. Environmental Protection Agency under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). The site is also listed as the top priority site in the State of South Carolina. Special notice letters were sent to approximately one hundred thirty-nine potentially responsible parties to give them the opportunity to conduct the RI/FS. An Administrative Order on Consent to perform the RI/FS was entered into by a group of forty-three of the PRPs on April 21, 1988.

3.0 COMMUNITY RELATIONS

An information repository for this site was established in the Landmark Square Branch of the Richland County Library on Garner's Ferry Road in Columbia, South Carolina. Information is also available in Atlanta, Georgia, in the EPA Region IV Regional Office. Fact sheets and press advisories were prepared prior to each public meeting. Prior to the Feasibility Study Public Meeting, a public notice ran in the local newspaper (The State).

A public availability session was held on June 7, 1989 to discuss the site status. A Community Relations Plan identifying a positive public outreach strategy was developed at the direction of EPA Region IV staff and submitted to the repository in October 1988. Another availability session was held November 2, 1989 in the Hopkins Community Center to present and discuss the findings of the Remedial Investigation. A Public Meeting was held on April 10, 1990 in the Hopkins Community Center to present to the public the findings of the Feasibility Study Report and to present the Agency's preferred alternative. This meeting also opened the public comment period. During the initial thirty day public comment period, a request for an extension was received by the Agency. The public comment period was extended an additional 30 days. The public comment period ended on June 10, 1990. The comments received are addressed in the Responsiveness Summary.

4.0 Scope of Response Action

The remedial action addressed by this ROD will prevent current or future exposure posed by this site. The action will remove the threat posed by contaminated groundwater at the site and will remediate the soil so that it no longer acts as a continuing source for the groundwater contamination. This is the only ROD contemplated for the site. No other operable units have been identified as necessary at this site.

5.0 Summary of Site Characteristics

5.1 Hydrogeological Setting

The stratigraphy of the study area may be divided into four hydrologically connected water-bearing units underlying the site. Hydrogeologic units are as follows:

- A shallow, surficial aquifer in the Okefenokee terrace, underlain by a clay or sandy clay aquitard, part of the Black Creek Formation
- A deep aquifer consisting of sand and clay, also part of the Black Creek Formation, underlain by another aquitard of sandy clay
- The deepest aquifer, the Middendorf Formation, consisting of sand, silt, and clay (which many geologists call the Tuscaloosa Aquifer)
- The crystalline pre-Mesozoic basement which has virtually no primary porosity but possibly has significant high secondary fracture porosity.

5.1.2 Local Hydrogeology of the Shallow Aquifer

The shallow aquifer typically extends to a depth of 45 to 50 feet and is composed primarily of sands which range from coarse and well sorted to silty and poorly sorted. It is semiconfined by a resistent layer composed of varying amounts of clay, silt, and sand which usually lies from the surface to a depth ranging from 5 to 15 feet.

The ground water table in the shallow aquifer generally lies 10 to 15 feet below ground surface based on the three rounds of ground water level measurements taken. The overall ground water flow is approximately to the east. The gradient of the potentiometric surface is about 0.003 near Bluff Road and flattens dramatically to less than 0.001 in the vicinity of MW-4, MW-6, MW-8, and MW-12. The Remedial Investigation data indicate that there is a downward head in the surficial aquifer and it could recharge the deeper aquifer. The surface in this area is very irregular and flow patterns are subject to local influences. Overall discharge may be to Myers Creek.

5.1.3 Local Hydrogeology of the Deep Aquifer

The deep aquifer is separated from the shallow aquifer by a clay and silt unit which ranges in thickness from 1.5 to 25 feet. This partial confining layer is thinnest in the vicinity of MW-6 and MW-7 and thickens to the south and west. The lithology of the deep aquifer is similar to that of the shallow aquifer, though clay-rich layers are more common. Both the clay aquitard and the deep aquifer are thought to be units in the Black Creek Formation.

The gradient of the potentiometric surface in the deep aquifer is 0.0003 ft/ft toward the south based on water level data gathered from the four wells installed by IT Corporation.

5.2 Site Contamination

In 1989, a remedial investigation (RI) involving sampling of the soil, surface waters, sediments, ground water, and air was conducted at the SCRDI site to define the characteristics and extent of contamination at the site. Comparison of the detected levels of specific compounds to developed target cleanup criteria is presented in Section 4.0.

5.2.1 Ground Water

5.2.1.1 Surficial Aquifer

Nineteen monitoring wells were installed in the surficial aquifer to define the extent and characteristics of ground water contamination. The analytical results defined a contaminant plume approximately 1000 feet wide extending approximately 2200 feet southeast of the site (see Figure 3). The depth of the surficial aquifer is approximately 40 feet. Based on a medium sand porosity of 0.4, the estimated volume of the plume is 263,296,000 gallons. The primary components of the contamination are volatile and semi-volatile organic compounds. The detected volatile and semi-volatile compounds, highest concentrations detected and frequency of detected are summarized in Table 1. Trace levels of semi-volatile compounds were detected in three wells. Detected metals, highest concentration and frequency of detection are summarized in Table 2. Additional work, including further groundwater investigation, will be required for the development of the Remedial Design.

5.2.1.2 Deep Aquifer

Four monitoring wells were installed in the upper portion of the deep aquifer regionally downgradient of the site. These wells were completed below a clay aquitard found to be continuous over the area encompassed by well installation. Analytical results for samples of these four lower aquifer wells showed no contamination, indicating the deep aquifer has not been impacted by contamination detected in the surficial aquifer.

5.2.2 Soils

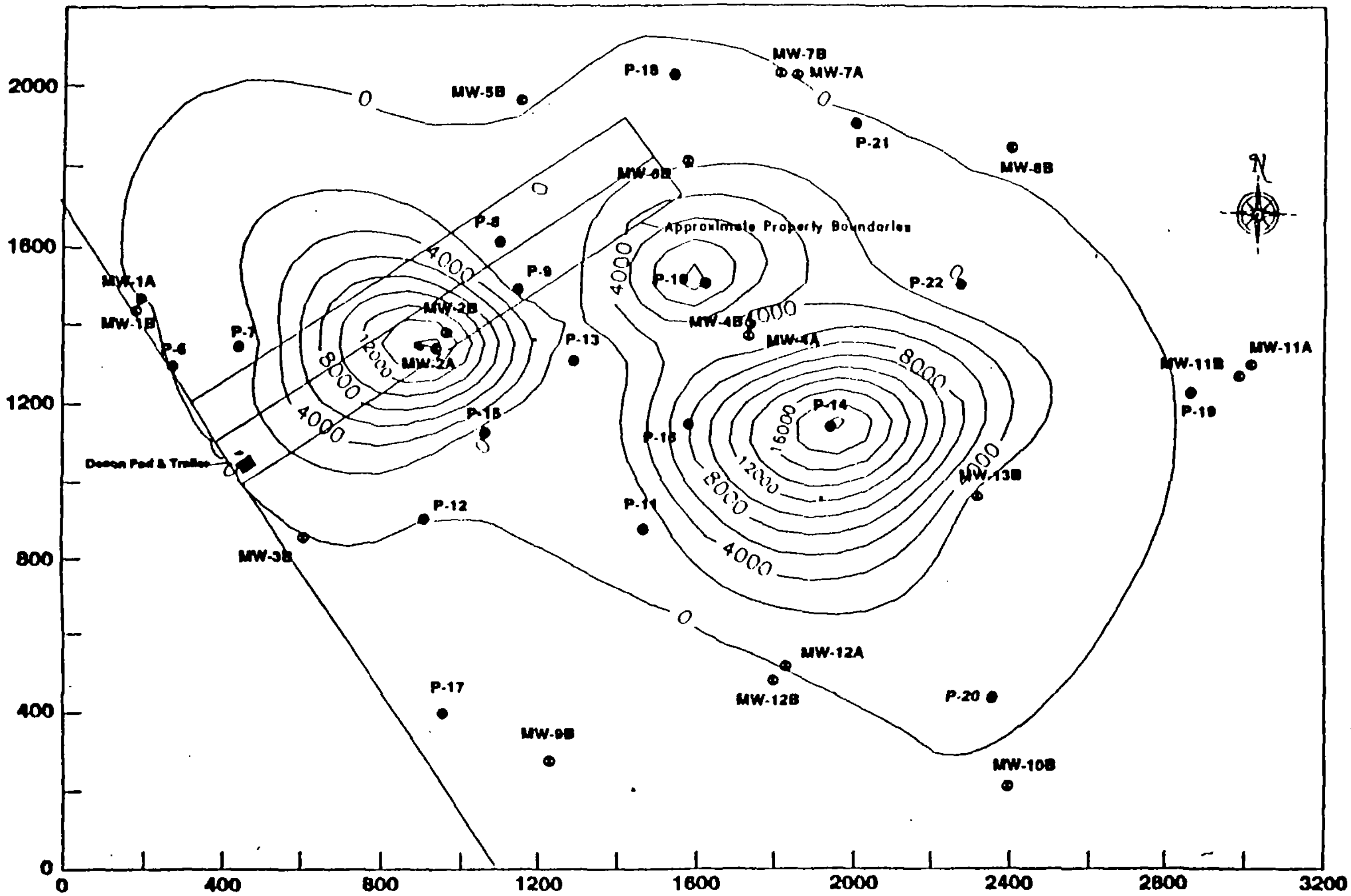
The RI investigated surface and subsurface soils as potential source areas contributing contaminants to the surficial aquifer. Dry lagoon sediments identified in the RI are included as soils for this and subsequent evaluations. Wet lagoon sediments are addressed in Section 3.2.3.1.

5.2.2.1 Surface Soils

Forty-two surface soil samples were taken on and off the site in areas of known or suspected contamination. Sampling locations and the areas of significant organic compound content are shown on Figure 4. The areas associated with volatile and semi-volatile detection are approximately the same. Tables 3 and 4 summarize the detected compounds, frequency of detection for volatile compounds and semi-volatile compounds respectively.

Two general areas of surface soil contamination were identified. The most significant area of surface soil contamination is found on the southwestern edge of the SCRDI Site and encompasses approximately 350 feet X 200 feet (70,000 sq ft).

A second area of surface soil contamination was identified in the central portion of the SCRDI property (the dry lagoon area) at lower concentrations than those seen at the southwestern edge of the property. This second area encompasses approximately 100 feet X 100 feet (10,000 sq ft).



LEGEND

CHEMICAL CONCENTRATION CONTOUR LINE (Concentration in parts per billion)

IT WELL (Installed 1988)

GOLDER WELL (Installed 1985)

SCALE: 1" = 435 ft

NOTE: CONTOUR INTERVAL = 2000 ppb

FIGURE 3

CHEMICAL CONCENTRATION DISTRIBUTION MAP FOR TOTAL VOAS IN ALL UPPER AQUIFER WELLS

INTERNATIONAL TECHNOLOGY CORPORATION

TABLE 1
GROUNDWATER SUMMARY
ORGANICS

COMPOUND	HIGH CONC. PPB	LOW CONC. PPB	HIGH LOCATION	NO. OF DETECTIONS/ NO. OF SAMPLES
VOLATILES				
Carbon Tetrachloride	200	ND	13B	7/23
Acetone	18000	2	2A	23/23
Chloroform	2000	ND	4B	10/23
Benzene	110	ND	2A	2/23
1,1,1-Trichloroethane	260	ND	13B	6/23
Methylene Chloride	35	ND	4A	7/23
Carbon Disulfide	4	ND	1A	1/23
1,1-Dichloroethane	2000	ND	2A	6/23
1,1-Dichloroethene	1200	ND	2A	7/23
1,2-Dichloropropane	21	ND	2A	3/23
2-Butanone	2100	ND	2A	1/23
1,1,2-Trichloroethane	9	ND	2A	3/23
Trichlorethene	220	ND	4A	6/23
1,1,2,2-Tetrachloroethane	440	ND	4A	6/23
Ethylbenzene	220	ND	2A	2/23
1,2-Dichloroethane	280	ND	2A	3/23
4-Methyl-2-Pentanone	98	ND	2A	1/23
Toluene	980	ND	2A	2/23
Chlorobenzene	16	ND	2A	1/23
Tetrachlorethene	68	ND	13B	7/23
1,2-Dichloroethene	6800	ND	2A	5/23
Total Xylenes	360	ND	2A	2/23
SEMI-VOLATILES				
Dicthylphthalate	2	ND	7C	1/23
N-Nitrosodiphenylamine	4	ND	7B	1/23
1,2-Dichlorobenzene	4	ND	4A	1/23

TABLE 2
GROUNDWATER SUMMARY
METALS

COMPOUND	HIGH CONC. PPB	LOW CONC. PPB	HIGH LOCATION	NO. OF DETECTIONS/ NO. OF SAMPLES
Aluminum	310	ND	2B	22/23
Iron	156	0.06	2A	23/23
Magnesium	15.6	0.336	2A	23/23
Manganese	3.04	0.011	2A	23/23
Nickel	0.185	ND	2B	23/23
Potassium	7.41	ND	2A	16/23
Sodium	37.5	ND	2A	22/23
Barium	3.27	0.01	2B	23/23
Beryllium	0.066	ND	2B	9/23
Cadmium	0.037	ND	7C	6/23
Chromium	0.315	ND	2B	10/23
Cobalt	0.154	ND	10B	9/23
Copper	0.411	ND	2B	17/23
Vanadium	0.833	ND	2B	9/23
Zinc	0.551	0.009	2B	23/23
Calcium	84.5	1.81	11A	23/23
Lead	0.257	ND	2B	13/23
Arsenic	0.004	ND	7C	1/23
Selenium	0.003	ND	7C	2/23
Mercury	0.0009	ND	2B	6/23

Low levels of pesticides/PCBs were also detected in the area of SS-4 and SS-5. Compounds detected, the location of the highest concentration detected and frequency of detection are summarized in Table 5.

A summary of metals detected, the location of the highest concentration detected, and frequency of detection is provided in Table 6. Two samples out of thirty-four (SS-4 and SS-5) had concentrations of mercury above the background range. The levels detected and the localized area indicate that metals in the surface soil are not of primary concern.

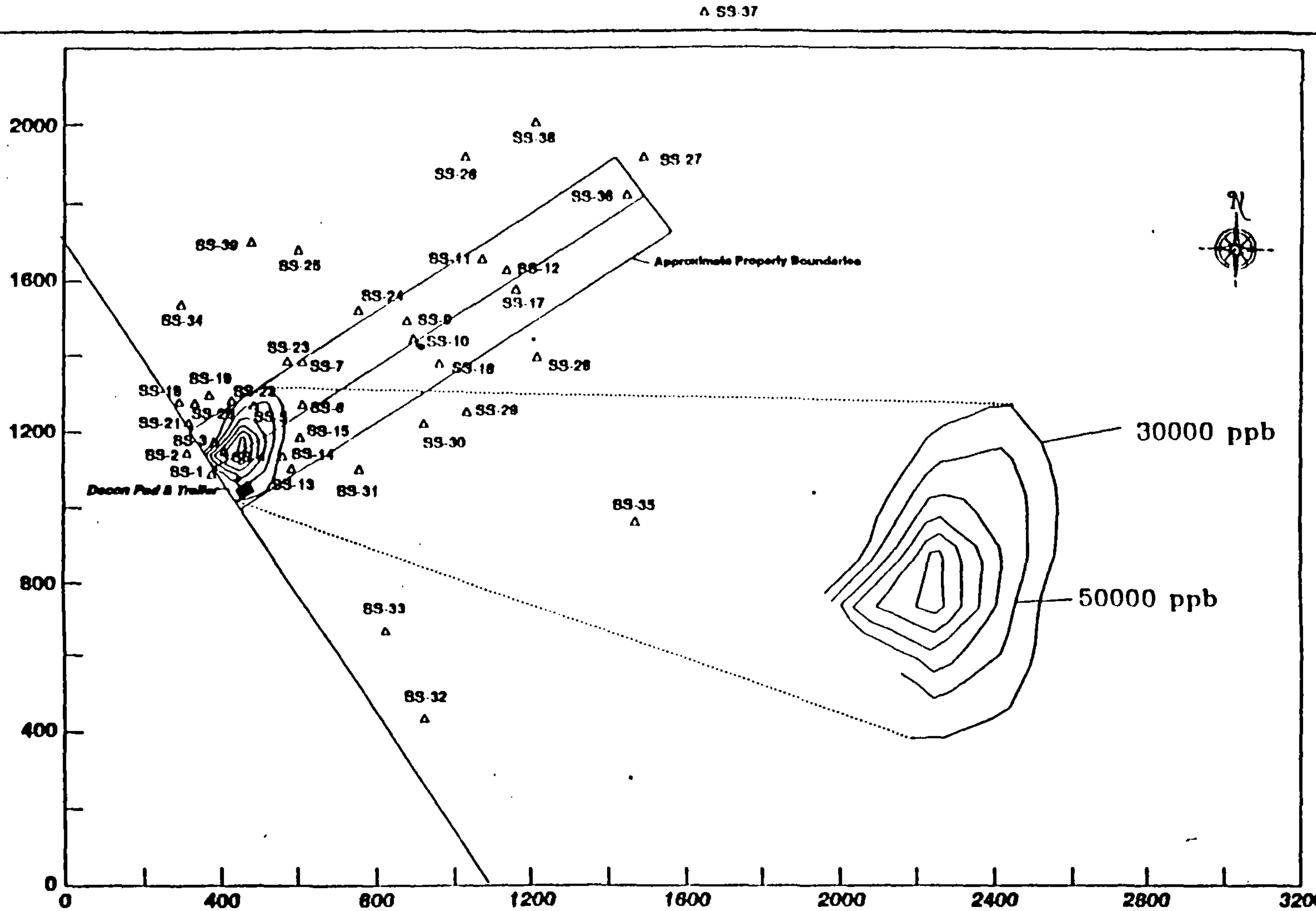
5.2.2.2 Subsurface Soils

Twenty-nine soil borings were taken on and off the site. Samples were taken at 3 to 7 and 7 to 11 foot intervals at each location. One additional sample at 11 to 15 feet was taken at B9. Figure 5 shows the sampling locations and areas of significant volatile compound content. The volatile compounds detected, the location of the highest concentration depth, and frequency of detection are summarized in Table 7. Elevated levels of volatile compounds are limited to the upper 7 feet of the unconsolidated zone. The areas of detected elevated levels are limited to the proximity of B8 and B9 (approximately 300 feet ENE of B4/B5). This encompasses an area of approximately 400 feet X 250 feet (112,500 sq ft) that essentially overlaps that area identified with elevated volatile concentrations in surface soils. Concentrations generally decreased with depth.

Semi-volatile compounds were also detected in the same limited areas of B4/B5 and B8/B9. The highest concentrations were primarily limited to the upper 7 feet of the unconsolidated zone with concentrations decreasing significantly with depth. Semi-volatile compounds detected, the location of the highest concentration and depth, second highest location and depth, and frequency of detection are summarized in Table 8.

Low levels of pesticides/PCBs were detected in the subsurface soils in the B5, B8/B9 area, limited to the upper 7 ft of the unconsolidated zone. Table 9 summarizes the compounds detected, the location of the highest concentration detected and frequency of detection.

A summary of metals detected, the location of the highest concentration detected and frequency of detection is provided in Table 10. One boring out of the twenty-nine taken (B13) has a concentration of selenium above the background range. The levels detected and the localized area indicate that metals in the surface soil are not of concern.



LEGEND

CHEMICAL CONCENTRATION CONTOUR LINE
(Concentration in parts per billion)

△ SURFACE SOIL SAMPLE

SCALE: 1" = 435 ft

NOTE: CONTOUR INTERVAL = 20000 ppb

FIGURE 4

CHEMICAL CONCENTRATION DISTRIBUTION MAP FOR TOTAL VOAs* IN SURFACE SOIL SAMPLES

* **EXCLUDES ACETONE AND METHYLENE CHLORIDE**

IT INTERNATIONAL TECHNOLOGY CORPORATION

TABLE 3
SURFACE SOIL SUMMARY
VOLATILES

COMPOUND	HIGH CONC. PPB	LOW CONC. PPB	HIGH LOCATION	NO. OF DETECTIONS/ NO. OF SAMPLES
Acetone	45,000	6	SS4	42/42
Chloroform	10,000	ND	SS5	3/42
1,1,1,-Trichloroethane	14,000	ND	SS5	4/42
Methylene Chloride	4,700	ND	DLS2	41/42
Carbon Disulfide	1	ND	SS14	1/42
1,1-Dichloroethane	390	ND	SS5	2/42
2-Butanone	55	ND	SS3	3/42
Trichloroethene	44,000	ND	SS5	8/42
1,1,2,2-Tetrachloroethane	100,000	ND	SS4	1/42
Ethylbenzene	710	ND	SS5	3/42
4-Methyl-2-Pentanone	3	ND	SS3	1/42
Toluene	29,000	ND	SS4	16/42
Chlorobenzene	16,000	ND	SS4	1/42
Tetrachloroethene	56,000	ND	SS4	8/42
1,2-Dichloroethene	45	ND	SS3	2/42
Total Xylenes	5,200	ND	SS4	4/42
Styrene	6	ND	SS38	1/42
Vinyl Chloride	24	ND	DLS1	1/42
1,1-Dichloroethene	240	ND	DLS3	2/42
Benzene	590	ND	DLS2	2/42
1,2-Dichloroethane	120	ND	DLS1	1/42

TABLE 4
SURFACE SOIL SUMMARY
SEMI-VOLATILES

COMPOUND	HIGH CONC. PPB	LOW CONC. PPB	HIGH LOCATION	NO. OF DETECTIONS/ NO. OF SAMPLES
Benzoic Acid	3,800	ND	SS38	19/42
Di-n-butylphthalate	2,200	ND	SS4	8/42
Naphthalene	1,200	ND	SS4	1/42
2-Methylphenol	58,000	ND	SS4	1/42
2-Chlorophenol	200,000	ND	SS4	2/42
2,4,5-Trichlorophenol	810	ND	SS4	1/42
Benzyl Alcohol	110,000	ND	SS4	1/42
4-Methyl Phenol	14,000	ND	SS4	3/42
Phenol	210,000	ND	SS5	31/42
Bis(2-Ethylhexyl) Phthalate	7,600	ND	SS5	41/42
Di-n-octylphthalate	44,000	ND	SS4	5/42
Hexachlorobenzene	7,200	ND	SS4	3/42
Isophorone	450	ND	SS4	1/42
2,4-Dichlorophenol	29,000	ND	SS4	1/42
Diethylphtalate	1,500	ND	SS4	1/42
N-Nitrosodiphenylamine	50	ND	SS21	1/42

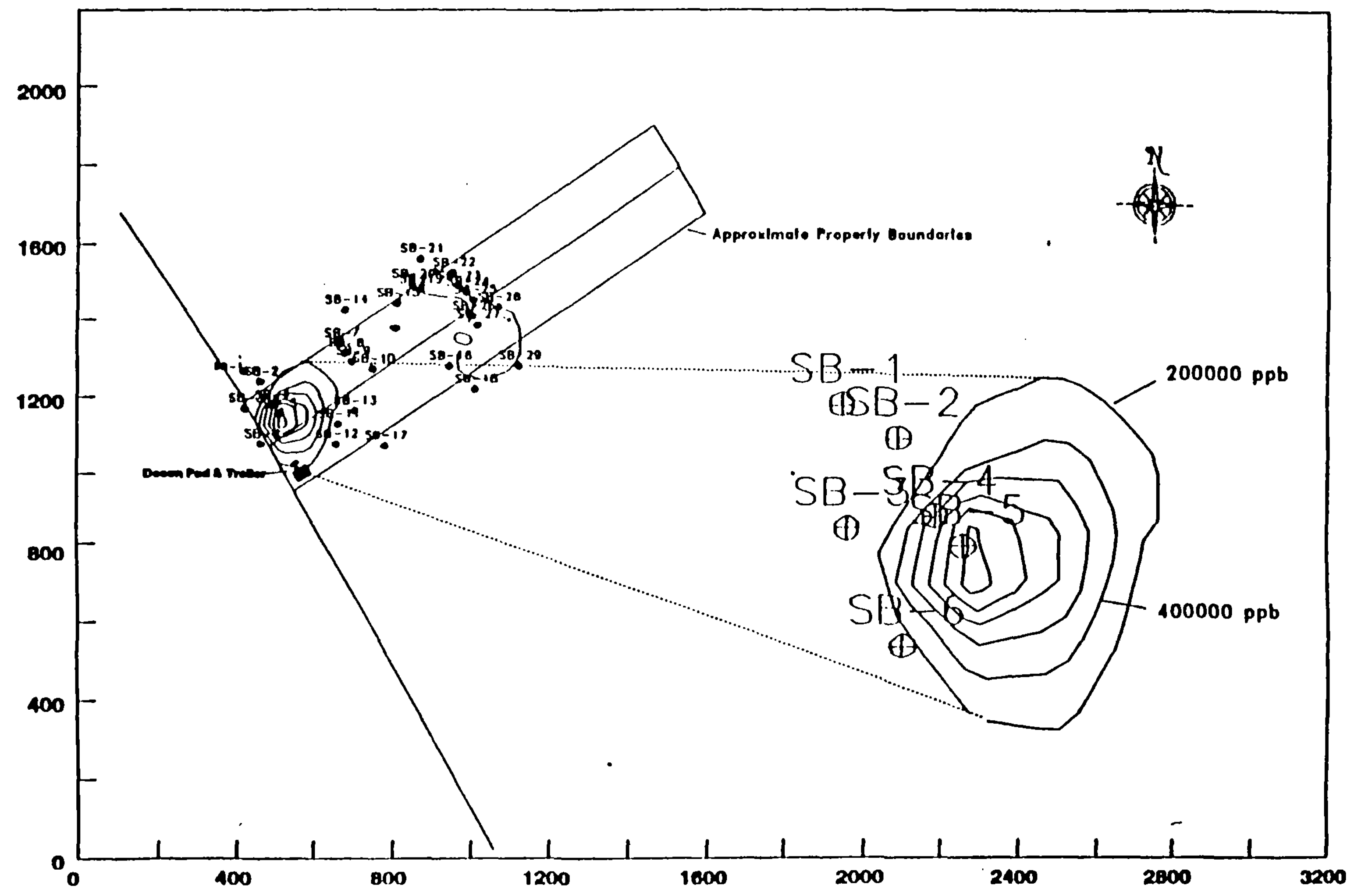
TABLE 5
SURFACE SOIL SUMMARY
PESTICIDES/PCB'S

COMPOUND	HIGH CONC. PPB	LOW CONC. PPB	HIGH LOCATION	NO. OF DETECTIONS/ NO. OF SAMPLES
4,4'-DDE	85	ND	SS5	3/42
4,4'-DDD	46	ND	SS19	1/42
4,4'-DDT	220	ND	SS4	4/42
Methoxychlor	2700	ND	SS4	3/42
Dieldrin	52	ND	SS20	1/42
Endosulfan II	26	ND	SS20	1/42
Arochlor 1242	1900	ND	SS5	2/42
Endosulfan Sulfate	600	ND	DLS3	1/42

TABLE 6
SURFACE SOIL SUMMARY
METALS

COMPOUND	HIGH CONC. PPM	LOW CONC. PPM	HIGH LOCATION	NO. OF DETECTIONS / NO. OF LOCATIONS	BLANK CONTAMINATION	ESTIMATED BACKGROUND CONCENTRATION RANGE PPM	ESTIMATED BACKGROUND CONCENTRATION AVERAGE PPM	NO. OF LOCATIONS ABOVE BACKGROUND RANGE
Aluminum	13,500	1170	SS18	34/34	NO	7000-100,000[a]	33,000	0
Iron	39,000	1310	SS11	34/34	NO	100-100,000[a]	14,000	0
Magnesium	813	16	SS4	34/34	NO	50-50,000[a]	2,100	0
Manganese	1,240	2.5	SS21	34/34	NO	2-7,000[a]	250	0
Nickel	34	ND	SS5	11/34	NO	5-700[a]	11	0
Potassium	2,690	ND	SS4	8/34	NO	50-37,000[a]	12,000	0
Silver	5	ND	SS18	5/34	NO	.01-5[b]	0.05[b]	0
Sodium	346	ND	SS5	23/34	NO	500-50,000[a]	2,500	0
Antimony	6	ND	SS18	2/34	NO	<1-8.8[a]	0.52	0
Barium	190	18	SS1	34/34	NO	10-1500[a]	290	0
Beryllium	1.3	ND	SS18	32/34	NO	<1-7[a]	0.55	0
Cadmium	4	ND	SS5	5/34	NO	<0.2-1[b]	0.5[b]	1
Chromium	64	2	SS4	34/34	NO	1-1000[a]	33	0
Cobalt	9	ND	SS5	16/34	NO	<0.3-70[a]	5.9	0
Copper	205	ND	SS5	32/34	NO	<1-700[a]	13	0
Vanadium	64	4	SS11	34/34	NO	<7-300[a]	43	0
Zinc	738	3	SS5	32/34	NO	<5-2900[a]	40	0
Calcium	94,800	86	SS24	34/34	no	100-280,000	3,400	0
Lead	158	7	SS5	34/34	NO	<10-300[a]	14	0
Arsenic	8.2	ND	SS5	15/34	NO	<0.1-73[a]	4.8	0
Selenium	3.6	ND	SS20	3/34	NO	<0.1-3.9[a]	0.3	0
Mercury	6.56	ND	SS5	29/34	NO	0.01-3.4[a]	0.081	2
Thallium	0.9	ND	SS17	7/34	NO	2.2-23	7.7	0

[a] USGS Paper 1270 (1984).
[b] Office of Toxic Substances, USEPA (1984)



LEGEND

CHEMICAL CONCENTRATION CONTOUR LINE (Concentration in parts per Million)

IT SOIL BORING (Installed 1989)

SCALE: 1" = 435 ft

NOTE: CONTOUR INTERVAL = 200000 ppb

FIGURE 5

CHEMICAL CONCENTRATION DISTRIBUTION MAP FOR TOTAL VOAs* IN SOIL BORINGS

* EXCLUDES ACETONE AND METHYLENE CHLORIDE

IT INTERNATIONAL TECHNOLOGY CORPORATION

TABLE 7
SOIL BORING SUMMARY
VOLATILES

COMPOUND	HIGH CONC. PPB	AVE ACROSS HIGH BORING	HIGH LOCATION	HIGH DEPTH FT	SECOND HIGH CONC. PPB	SECOND HIGH LOCATION	SECOND HIGH DEPTH	NO. OF DETECTIONS/ NO. OF LOCATIONS
Carbon Tetrachloride	4,100*	2,050	B5	3-7	0	N/A	N/A	1/29
Acetone	160,000*	92,000	B5	3-7	5400	B7	3-7	29/29
Chloroform	160	81.5	B8	3-7	51	B9	7-11	4/29
Benzene	7	2.3	B9	7-11	3	B8	3-7	2/29
1,1,1-Trichloroethane	6,800*	3,400	B5	3-7	220	B9	7-11	3/29
Methylene Chloride	39,000*	22,750	B5	3-7	140	B9	7-11	29/29
Carbon Disulfide	2	1	B13	7-11	2	B15	7-11	2/29
1,1-Dichloroethane	69	23	B9	7-11	3	B13	7-11	5/29
1,1-Dichloroethene	44	27.7	B9	11-15	4	B13	7-11	2/29
2-Butanone	89,000*	51,500	B5	3-7	1400	B4	3-7	13/29
1,1,2-Trichloroethane	7	2.3	B9	7-11	0	N/A	N/A	1/29
Trichloroethene	25,000	12,500	B5	3-7	220	B9	7-11	3/29
1,1,2,2-Tetrachloroethane	2,300,000	1,260,000	B5	3-7	1100	B9	3-7	9/29
Ethylbenzene	18,000	9,000	B5	7-11	630	B9	3-7	5/29
4-Methyl-2-Pentanone	340	186	B4	7-11	18	B9	11-15	4/29
Toluene	340,000	174,800	B5	3-7	1000	B9	7-11	29/29
Chlorobenzene	23,000*	11,500	B5	3-7	3	B8	3-7	2/29
Tetrachlorethene	95,000	47,500	B5	3-7	940	B8	3-7	5/29
1,2-Dichloroethylene	40	17.3	B9	7-11	0	N/A	N/A	1/29
Total Xylenes	62,000	31,000	B5	3-7	3600	B9	7-11	11/29

*Duplicate is significantly lower. Higher values used for this summary.

29 soil boring, samples at every location taken at 3-7'ft, 7-11'ft; at B-9 an additional sample at 11-15'ft was taken, total of 59 samples not including duplicates.

TABLE 8
SOIL BORING SUMMARY
SEMI-VOLATILES

COMPOUND	HIGH CONC. PPB	AVE ACROSS HIGH BORING	HIGH LOCATION	HIGH DEPTH FT	SECOND HIGH CONC. PPB	SECOND HIGH LOCATION	SECOND HIGH DEPTH	NO. OF DETECTIONS/ NO. OF LOCATIONS
Benzoic Acid	110,000	54,333	B9	3-7	5,400	B7	7-11	7/29
Hexachloroethane	1200	600	B5	3-7	0	N/A	N/A	1/29
Di-N-Butylphthalate	250	125	B8	3-7	92	B1	3-7	3/19
N-Nitrosodiphenylamine	820	410	B5	3-7	260	B27	3-7	11/29
2,4,6-Trichlorophenol	280	140	B5	3-7	0	N/A	N/A	1/29
Naphthalene	3900	1,950	B5	3-7	0	N/A	N/A	1/29
2-Methylphenol	120,000	65,500	B5	3-7	63	B4	7-11	2/29
2-Chlorophenol	2,000,000	1,033,500	B5	3-7	290	B12	3-7	5/29
2,4,5-Trichlorophenol	200	100	B5	3-7	0	N/A	N/A	1/29
Nitrobenzene	11,000	5,685	B5	7-11	0	N/A	N/A	1/29
Benzyl Alcohol	330,000	182,000	B5	3-7	230,000	B9	3-7	2/29
4-Methylphenol	3,600	1,800	B5	3-7	260	B4	7-11	3/29
Phenol	6,300,000	3,375,000	B5	3-7	1,800	B9	7-11	7/29
Bis(2-Ethylhexyl) Phthalate	2,400	1,800	B8	3-7	1,900	B5	3-7	29/29
Di-N-Octyl Phthalate	1,700	850	B8	3-7	650	B5	3-7	3/29
Hexachlorobenzene	190	63.3	B9	7-11	0	N/A	N/A 1/29	
2,4-Dichlorophenol	130,000	65,000	B5	3-7	0	N/A	N/A	1/29

5.2.3 Other Media

5.2.3.1 On-site Surface Water and Surface Water Sediment

The wet lagoon water and sediment samples contained trace amounts of volatile and semi-volatile constituents. Sediment metals concentrations were within background ranges with the exception of calcium. Summaries for compounds detected and frequencies are provided in Tables 11 & 12.

5.2.3.2 Off-Site Surface Water and Surface Water Sediment

Samples of off-site surface water and surface water sediment indicated no site related contamination. One sample (RS2) showed an elevated level of the naturally occurring compound benzoic acid.

5.2.3.3 Ambient Air

Ambient air samples were collected on the SCRDI property. Toluene was detected in two of three bag samples at 22 and 27 ppb. No other constituents were detected. Air contamination is not considered to be significant at the site.

5.3 Risk Assessment Summary

A baseline risk assessment was performed as part of the Remedial Investigation to evaluate the potential for off-site migration of constituents from the site and the impacts on public health and/or the environment. The baseline risk is associated with the No-Action Alternative.

The extent of constituents in environmental media at the SCRDI site was shown to be limited to the on-site soils and shallow ground water aquifer underlying the site. Elevated levels of site related constituents were not found in off-site soil samples, sediment or water samples from drainage ditches, the deep ground water aquifer, or in surface water in local creeks.

The primary potential route of off-site migration was shown to be via the shallow ground water aquifer. This aquifer may recharge Myers creek, 3,200 feet northeast of the site boundary. However, site-related constituents have not been detected in Myers Creek.

Direct consumption of ground water from the surficial aquifer within the contaminant plume would present unacceptable levels of exposure. A trespasser scenario indicated that the presence of site-related constituents in the soils do not present a significant risk to the health of trespassers on the site.

TABLE 9
SOIL BORING SUMMARY
METALS

COMPOUND	HIGH CONC. PPB	HIGH LOCATIONS	NO. OF DETECTION/ NO. OF LOCATIONS	ESTIMATED BACKGROUND CONCENTRATION RANGE PPM	ESTIMATED BACKGROUND CONCENTRATION AVERAGE PPM	NO. OF LOCATIONS ABOVE BACKGROUND RANGE
Aluminum	22,100	B25	29/29	7000-100,000[a]	33,000	0
Iron	22,700	B7	29/29	100-100,000[a]	14,000	0
Magnesium	816	B25	29/29	50-50,000[a]	2,100	0
Manganese	211	B2	29/29	2-7,000[a]	250	0
Nickel	8	B8	10/29	5-700[a]	11	0
Potassium	663	B8	10/29	50-37,000[a]	12,000	0
Silver	2.1	B14	3/29	0.01-5[b]	0.05	0
Sodium	800	B28	26/29	500-50,000[a]	2,500	0
Barium	103	B25	29/29	10-1500[a]	290	0
Beryllium	1	B25	23/29	<1-7[a]	0.55	0
Cadmium	0.7	B26	2/29	<0.2-1[b]	0.50	
Chromium	24	B25	29/29	1-1000[a]	33	0
Cobalt	13	B25	8/29	1-1000[a]	5.9	0
Copper	30	B7	29/29	0.3-70[a]	13	0
Vanadium	42	B7	29/29	<1-700[a]	43	0
Zinc	34	B8	29/29	<7-3400[a]	40	0
Calcium	3,630	B15	29/29	<5-2900[a]	3,400	0
Lead	28	B13	29/29	100-280,000[a]	14	0
Arsenic	0.4	B4	1/29	<10-300[a]	4.8	0
Thallium	0.4	B23	1/29	<0.1-73[a]	7.7	0
Selenium	9.7	B13	5/29	<0.1-3.9[a]	0.3	1
Mercury	0.37	B5	13/29	0.01-3.4[a]	0.081	0

[a] USGS Paper 1270 (1984).
[b] Office of Toxic Substances, USEPA (1984).

TABLE 10
SOIL BORING SUMMARY
PESTICIDES AND PCB'S

COMPOUND	HIGH CONC. PPB	AVE ACROSS HIGH BORING	HIGH LOCATION	HIGH DEPTH FT	SECOND HIGH CONC. PPB	SECOND HIGH LOCATION	SECOND HIGH DEPTH	NO. OF DETECTIONS/ NO. OF LOCATIONS
Lindane	12	6	B8	3-7	0	N/A	N/A	1/29
Aroclor 1242	510	170	B9	3-7	260	B8	3-7	2/29
Methoxychlor	160	80	B5	3-7	0	N/A	N/A	1/29
Toxaphene	470	235	B5	3-7	0	N/A	N/A	1/29
Heptachlor	86	43	B5	3-7	0	N/A	N/A	1/29
Eldrin Ketone	47	23.5	B5	3-7	0	N/A	N/A	1/29

TABLE 11
WET LAGOON SEDIMENT SUMMARY
ORGANICS

VOLATILES

COMPOUND	HIGH CONC. CONC. PPB	NO. OF DETECTIONS/ LOCATIONS
Methylene Chloride	35	3/3
Acetone	340	3/3
Carbon Disulfide	10	2/3
Toluene	5	2/3

SEMI-VOLATILES

COMPOUND	HIGH CONC. CONC. PPB	NO. OF DETECTIONS LOCATIONS
Bis(2-ethylhexyl) phthalate	1700	3/3
Phenol	800	1/3
Di-n-butylphalate	180	2/3

PESTICIDES/PCBs

COMPOUND	HIGH CONC. CONC. PPB	NO. OF DETECTIONS LOCATIONS
ND	ND	0/3

TABLE 12
WET LAGOON SEDIMENT SUMMARY
METALS

COMPOUND	HIGH CONC. CONC. PPB	NO. OF DETECTIONS/ NO. OF SAMPLES
Aluminum	14,500	3/3
Antimony	6	1/3
Arsenic	1.6	1/3
Barium	164	3/3
Beryllium	0.8	3/3
Calcium	443,000	3/3
Chromium	42	3/3
Copper	13	3/3
Iron	7,710	3/3
Lead	19	3/3
Magnesium	494	3/3
Manganese	108	3/3
Mercury	0.62	2/3
Nickel	13	1/3
Sodium	428	3/3
Vanadium	29	3/3
Zinc	32	3/3
Cyanide	13.2	1/3

The predicted constituent concentrations in Myers Creek that could result from direct undiluted discharge of the plume into the creek would not have a significant impact upon the indigenous aquatic populations. The predicted chemical concentrations in Myers Creek are over three orders of magnitude lower than the maximum acceptable toxicant concentration (MATCs) for the most sensitive species which may be found in Myers Creek.

The effects or potential for bioconcentrations or bioaccumulation were determined to be negligible at the site.

6.0 Clean-up Criteria (ARARs)

6.1 Chemical Specific ARARs

6.1.1 Ground water

Ground water at the Bluff Road Site is designated as Class GB in accordance with the South Carolina water classification system. The GB designation is used to classify water quality suitable as a potential drinking water supply. Therefore, Federal and State regulations governing the quality and usage of drinking water is applicable.

The Safe Drinking Water Act and the State Primary Water Regulations establish Maximum Contaminant Levels (MCLs) and non-zero maximum contaminant level goals (MCLGs) for numerous organic and inorganic constituents. The Cleanup Criteria shown in Table 13 were established based on MCLs and proposed MCLs. Where MCLs were not available, risk based numbers were calculated as indicated by the appropriate table footnotes.

6.1.2 Soils

Although there were no chemical specific ARARs identified for site soils, the potential for contaminants leaching from the soils as a continuing source that could further degrade ground water quality was considered. Therefore, a soil leachability model was used to calculate cleanup criteria as shown in Tables 14 & 15. Where the model calculated soil cleanup criteria lower than the ground water MCL for a specific constituent, the MCL was used as the soil concentration. The model and appropriate calculations are provided in Appendix A of the final draft Feasibility Study Report.

6.2 Location Specific ARARs

Since the Bluff Road Site may affect Myers Creek through discharge from the shallow aquifer, the Fish and Wildlife Coordination Act would be applicable. Portions of the site and surrounding areas have been designated as wetlands, therefore, the following ARARs apply:

TABLE 13
GROUNDWATER CLEANUP CRITERIA

VOLATILES

COMPOUND	TARGET CLEANUP LEVELS (PPM)	NO. OF LOCATIONS EXCEEDING TCL/ NO. OF SAMPLES
Carbon Tetrachloride	5.00E-03[a]	6/23
Acetone	1.10E+00[d]	1/23
Chloroform	2.09E-02[c]	5/23
Benzene	5.00E-03[a]	2/23
1,1,1-Trichloroethane	2.00E-01[a]	1/23
Methylene Chloride	1.70E-02[c]	2/23
1,1-Dichloroethane	5.00E-03[a]	5/23
1,1-Dichloroethene	7.00E-03[a]	3/23
1,2-Dichloropropane	5.00E-03[a]	1/23
2-Butanone	5.50E-01[d]	1/23
1,1,2-Trichloroethane	2.20E-03[c]	2/23
Trichlorethene	5.00E-03[a]	5/23
1,1,2,2-Tetrachloroethane	6.00E-04[c]	6/23
Ethylbenzene	7.00E-01[a]	0/23
1,2-Dichloroethane	5.00E-03[a]	3/23
4-Methyl-2-Pentanone	5.50E-01[d]	0/23
Toluene	2.00E+00[a]	0/23
Chlorobenzene	1.00E-01[a]	0/23
Tetrachlorethene	5.00E-03[a]	5/23
1,2-Dichloroethene	7.00E-02[a]	3/23
Total Xylenes	1.00E+01[a]	0/23
2-Chlorophenol	5.50E-02[d]	0/23
METALS		
Iron	3.00E-01[e]	16/23
Manganese	5.00E-02[e]	18/23
Barium	1.00E+00[a]	2/23
Cadmium	5.00E-03[a]	2/23
Chromium	5.00E-02[a]	3/23
Copper	1.00E+00[e]	0/23
Zinc	5.00E+00[e]	0/23
Lead	5.00E-03[a]	3/23
Arsenic	5.00E-02[a]	0/23
Selenium	1.00E-02[a]	0/23
Mercury	2.00E-03[a]	0/23

[a]SWDA, MCLs, proposed MCLS, non-zero MCLGs.
[c]Derived from CPF and exposure model.
[d]Derived from RFD and exposure model.
[e]South Carolina MCL's for Class GB groundwater.

TABLE 14
SOIL CLEANUP CRITERIA

COMPOUND	TARGET CLEANUP LEVEL-PPM	NO. OF LOCATIONS > TCL / NO. OF SAMPLE LOCATIONS
Carbon Tetrachloride	5.30E-02	1/71
Acetone	1.10E+00[a]	14/71
Chloroform	2.10E-02	5/71
1,1,1,-Trichloroethane	1.03E+00	2/71
Methylene Chloride	1.70E-02[a]	20/71
1,1-Dichloroethane	6.00E-03	3/71
2-Butanone (MEK)	5.50E-02[a]	3/71
Trichloroethene	1.80E-02	8/71
1,1,2,2-Tetrachloroethane	1.00E-03	9/71
Ethylbenzene	2.23E+01	0/71
4-Methyl-2-Pentanone	5.50E-01[a]	0/71
Toluene	1.74E+01	2/71
Chlorobenzene	9.56E-01	2/71
Tetrachloroethene	5.30E-02	9/71
1,2-Dichloroethene	1.20E-01	0/71
Total Xylenes	6.95E+01	0/71
Vinyl Chloride	3.00E-03	1/71
1,1-Dichloroethene	1.30E-02	3/71
Benzene	1.20E-02	1/71
1,2-Dichloroethane	5.00E-03	2/71
2-Chlorophenol	5.50E-01	3/71
Phenol	3.95E+00	4/71
1,1,2 Trichloroethane	1.00E-03	1/71

[a]Ground Water Target Cleanup Level.

TABLE 15
WET LAGOON SEDIMENT CLEANUP CRITERIA

VOLATILES

COMPOUND	TARGET CLEANUP LEVEL PPM	LOCATIONS > TCL
Methylene Chloride	1.70E-02	2
Acetone	1.10E+00	0
Toluene	1.74E+01	0

SEMI-VOLATILES

COMPOUND	TARGET CLEANUP LEVEL-PPM	LOCATIONS > TCL
Phenol	3.95E+00	0

TABLE 16
ACTION-SPECIFIC ARARs FOR SOIL AND GROUNDWATER TREATMENT
BLUFF ROAD - SCRDI

ARARS	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARARS
A. COMMON TO ALL ALTERNATIVES:			
OSHA-General Industry Standards 29CFR 1910)	Applicable	These regulations specify the 8-hour time-weighted average concentration for worker exposure to various organic compounds. Training requirements for workers at hazardous waste operations are specified in 29 CFR 1910.120.	Proper respiratory equipment will be worn if it is not possible to maintain the work atmosphere below these concentrations.
OSHA-Safety and Health Standards (29CFR 1926)	Applicable	This regulation specifies the type of safety equipment and procedures to be followed during site remediation.	All appropriate safety equipment will be on-site and appropriate procedures will be followed during treatment activities.
OSHA-Record keeping, reporting and Related Regulations, (29 CFR 1904)	Applicable	This regulation outlines the record keeping and reporting requirements for an employer under OSHA.	These regulations apply to the company(s) contracted to install, operate, and maintain the treatment site.
RCRA-Standards for Owners/Operators of Permitted Hazardous Waste Facilities (40 CFR 264.10-264.18)	Relevant & Appropriate	General facility requirements outline general waste analysis, security measures, inspections and training requirements.	Facility will be designed, constructed, and operated in accordance with this requirement. All workers will be properly trained.
RCRA-Preparedness and Prevention (40 CFR 264.30-264.31)	Relevant & Appropriate	This regulation outlines the requirements for safety equipment and spill control.	Safety and communication equipment will be installed at the site. Local authorities will be familiarized with the site.
RCRA-Contingency Plan and Emergency Procedures (40 CFR 264.50-264.56),	Relevant & Appropriate	This regulation outlines the requirements for emergency procedures to be used following explosions, fires, etc.	Plans will be developed and implemented during remedial design. Copies of the plan will be kept on-site.
RCRA-Closure and Post-Closure (40 CFR 264.110-264.120)	Relevant & Appropriate	The regulations details specific requirements for closure and post-closure of hazardous waste facilities.	Since groundwater will be cleaned to drinking water standards, post-closure standards will be met.
<u>Waste Transportation:</u>			
DOT Rules for Transportation of Hazardous Materials (49 CFR Parts 107, 171.1-172.558)	Applicable	This regulation outlines procedures for the packaging, labeling, manifesting, and transporting of hazardous materials.	This regulation will be applicable to any company contracted to transport hazardous material from the site.

TABLE 16 (CONTINUED)

ARARS	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARARS
Thermal Treatment:			
40 CFR 60.52: NSPS	Applicable	Provides particulate emission limits for incinerators.	Particulate emission limits should be specified for compliance.
40 CFR 264: Subpart O	Applicable	Provides performance standards for hazardous waste incinerators.	Performance standards should be specified for compliance.
40 CFR 264.341-345	Applicable	Provides performance standards and closure requirements for incinerator design and operation for destruction on POHC, and limits emissions of HCl, particulates, and carbon monoxide.	Proper designs will be implemented to meet these requirements.
40 CFR 264.347	Applicable	Provides monitoring and inspection requirements while incinerating waste.	These requirements will be included to meet these regulations.
40 CFR 264. 351	Applicable	Provides requirements for disposal of incinerated ash, scrubber waste, and scrubber sludge.	These requirements will be included to meet these regulations.
CAA-NAAQS (40 CFR 1-99)	Applicable	Applies to major stationary sources such as treatment units that have the potential to emit significant amounts of pollutants such as NO_x SO_2, CO, lead, mercury and particulates (more than 250 tons/year). Regulations under CAA do not specifically regulate emissions from hazardous waste incinerators, but it is likely that Prevention of Significant Deterioration (PSD) provisions would apply to an on-site treatment facility.	The treatment system will be designed to meet these emission limits. PSD procedure was not included in this phase of FS.
Interim RCRA/CERCLA Guidance on Non-Contiguous Sites and On-Site Management of Waste and Treated Residue (USEPA Policy Statement, March 27, 1986)	To be Considered	If a treatment or storage unit is to be constructed for on-site remedial action, there should be a clear intent to dismantle, remove, or close the unit after the CERCLA action is completed.	Only properly permitted facilities will be considered for disposal of hazardous materials.

TABLE 16 (CONTINUED)

ARARS	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARARS
Waste Transportation (Cont'd):			
Standards Applicable to Transporters of Hazardous Waste-RCRA Section 3003, (40 CFR 262 and 263, 40 CFR 170 to 179)	Applicable	Establishes the responsibility of off-site transporters of hazardous waste in the handling transportation, and management of the waste. Requires a manifest, recordkeeping, and immediate action in the event of a discharge of hazardous waste.	This regulation will be applicable to any company contracted to transport hazardous material from the site.
Disposal:			
RCRA Land Disposal Restrictions (40 CFR 268, Subpart D)	Applicable	Since November 8, 1988, movement of excavated materials to new location and placement in or on land triggers land disposal restrictions.	Any regulated contaminants found in soils excavated will be properly disposed or treated as required by the regulations.
EPA Administered Permit Program: The Hazardous Waste Permit Program RCRA Section 3005, 40 CFR 270, 124	Applicable	Covers the basic permitting, application, monitoring and reporting requirements for off-site hazardous waste management facilities.	Any off-site facility accepting hazardous waste from the site must be properly permitted. Implementation of the alternative will include consideration of requirements.
B. SOIL TREATMENT:			
Excavation:			
40 CFR 262: RCRA	Applicable	Establishes standards for generators of hazardous wastes including waste determination, manifests, and pre-transport requirements.	This regulation will be applicable upon excavation and on-site storage of site wastes.
Clean Closure:			
RCRA-General Standards (40 CFR 264.111)	Relevant & Appropriate	General performance standard requires minimization of need for further maintenance and control; minimization or elimination of post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated runoff, or hazardous waste decomposition products. Also requires disposal or decontamination of equipment, structures, and soils.	Proper design considerations will be implemented to minimize the need for future maintenance. Decontamination facility will be included.

TABLE 16 (CONTINUED)

ARARS	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARARS
Thermal Treatment:			
40 CFR 60.52: NSPS	Applicable	Provides particulate emission limits for incinerators.	Particulate emission limits should be specified for compliance.
40 CFR 264: Subpart O	Applicable	Provides performance standards for hazardous waste incinerators.	Performance standards should be specified for compliance.
40 CFR 264.341-345	Applicable	Provides performance standards and closure requirements for incinerator design and operation for destruction on POHC, and limits emissions of HCl, particulates, and carbon monoxide.	Proper designs will be implemented to meet these requirements.
40 CFR 264.347	Applicable	Provides monitoring and inspection requirements while incinerating waste.	These requirements will be included to meet these regulations.
40 CFR 264. 351	Applicable	Provides requirements for disposal of incinerated ash, scrubber waste, and scrubber sludge.	These requirements will be included to meet these regulations.
CAA-NAAQS (40 CFR 1-99)	Applicable	Applies to major stationary sources such as treatment units that have the potential to emit significant amounts of pollutants such as NO_x SO_2, CO, lead, mercury and particulates (more than 250 tons/year). Regulations under CAA do not specifically regulate emissions from hazardous waste incinerators, but it is likely that Prevention of Significant Deterioration (PSD) provisions would apply to an on-site treatment facility.	The treatment system will be designed to meet these emission limits. PSD procedure was not included in this phase of FS.
Interim RCRA/CERCLA Guidance on Non-Contiguous Sites and On-Site Management of Waste and Treated Residue (USEPA Policy Statement, March 27, 1986)	To be Considered	If a treatment or storage unit is to be constructed for on-site remedial action, there should be a clear intent to dismantle, remove, or close the unit after the CERCLA action is completed.	Only properly permitted facilities will be considered for disposal of hazardous materials.

TABLE 16 (CONTINUED)

ARARS	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARARS
CAA-NAAQS for Particulate Matter Less Than 10 Microns in Diameter (40 CFR Part 60, Appendix J	Relevant & Appropriate	This regulation specifies maximum annual arithmetic mean and maximum 24-hour	Equipment will be designed to meet these requirements.
C. GROUNDWATER TREATMENT:			
Discharge of Treated Groundwater: 40 CFR 122.41 and 44	Relevant & Appropriate	Requires use of best available technology (BAT) to control toxic and nonconventional pollutants; use of best conventional pollutant control technology (BCT) for conventional pollutants. Technology-based limitations may be determined on a case-by-case basis.	The water treatment system will be designed constructed, and operated to ensure that all discharge effluents are in compliance with the NPDES requirements.
South Carolina Pollution Control Act	Relevant & Appropriate	Provides requirements for discharges to the waters of South Carolina	The water treatment will be designed, constructed, and operated to ensure that all discharge effluents are in compliance with these requirements.
Ambient Water Quality Criteria	To Be Considered	Provides requirements for discharges to streams which are protective of aquatic life	Same as above.
40 CFR 144.12, 144.13, 144.16, 144.28, 144.51, 144.55	Relevant & Appropriate	Provides criteria for injection of treated water	Treated water will be analyzed to meet these criteria.
40 CFR 147	Relevant & Appropriate	Provides requirements to comply with State underground injection regulations.	Proper design of injection system will be implemented to these regulations.
South Carolina Underground Injection Regulations	Applicable	Provides underground injection standards in South Carolina	Same as above.

TABLE 16 (CONTINUED)

ARARS	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARARS
<u>Air Emissions</u>			
NESHAP (40 CFR 61)	Applicable	Provides emission standards for hazardous air pollutants such as beryllium, mercury, vinyl chloride, benzene, arsenic, and lead.	Proper designs on air emissions controls will be implemented to these regulations.
NAAQS (40 CFR 50)	Applicable	Provides air quality standards for particulates lead and ozone.	Same as above.
PSD (40 CFR 51, 2)	Applicable	New major stationary sources may be subject to PSD review, i.e., require best available control technology (BACT), lowest achievable emission limit (LAEL), and/or emission offsets.	PSD procedures have not been included in this FS but could be expanded to BACT and LAER evaluations.
South Carolina Pollution Control Act	Applicable	Provides air quality standards for emissions in South Carolina	Proper designs on air emissions controls will be implemented to these regulations.

TABLE 17 OTHER FEDERAL AND STATE CRITERIA, ADVISORIES AND GUIDANCE, TO-BE-CONSIDERED (TBC)

REQUIREMENTS	RATIONALE
1. Health Advisories, EPA Office of Drinking Water	RI Activities identified presence of chemicals for which health advisories are listed
2. Reference Doses (R_fDs), EPA Office of Research and Development	Considered in the public health evaluation
3. Health Effects Assessments	Considered in the public health evaluation
4. Carcinogenic Potency Factors, EPA Environmental Criteria and Assessment Office, EPA Carcinogen Assessment Group	Considered in the public health evaluation
5. U.S. Environmental Protection Agency Exposure Factors Handbook, 1989	Considered in the public health evaluation
6. Agency for Toxic Substances and Disease Registry, Toxicological Profiles	Considered in the public health evaluation
7. U.S. Environmental Protection Agency Risk Assessment Guidance for Superfund Human Health Manual Part A, Interim Final, 1989b	Considered in the public health evaluation
8. CERCLA Compliance With Other Laws Manual, 1988a	Considered in the public health evaluation

- o Clean Water Act, Section 404
- o Protection of Flood Plain (40 CFR 6, Appendix A) Fish and Wildlife Coordination Act
- o General RCRA Facility Location Standards (40 CFR 264.18)

6.3 Action Specific ARARs

The action specific ARARs for this site are summarized in Table 16. The ARARs are divided into three categories:

- o ARARs for actions taken in all alternatives
- o ARARs for actions involving soil treatment
- o ARARs for actions involving ground water treatment

The first category is requirements for safety and health, hazardous waste facilities, and transportation. The second category is requirements for excavation, thermal treatment, soil vapor extraction, and clean closure of site soils. The third category includes ARARs concerning discharge of treated ground water and related air emissions.

6.4 Other Criteria, Advisories and Guidance

Other to-be-considered (TBC) Criteria, Advisories and Guidance which were used in the public health evaluations and determinations of some of the cleanup criteria are shown in Table 17.

7.0 Documentation of Significant Changes

The preferred alternative presented in the proposed plan identified excavation and treatment by thermal desorption of contaminated soils at the site and extraction and treatment by air stripping/carbon adsorption of contaminated groundwater. The source control (soil) remedial action presented in this ROD differs from the proposed plan in that this ROD documents selection of soil vacuum extraction as the preferred alternative for treating contaminated soil at the site. Soil vacuum extraction was chosen over thermal desorption based on preliminary pilot tests indicating the semi-volatile contaminants can be removed using the soil vacuum extraction technique. The pilot test also demonstrated that the clay layers and saturated conditions will not pose the impediment originally anticipated. The results of the pilot test give a good indication that the cleanup criteria are achievable using soil vacuum extraction.

8.0 Alternative Evaluation

8.1 No Action Alternative

The no-action alternative serves as a baseline for comparison of the overall effectiveness of each ground water remediation alternative.

8.1.1 Technical Description

The no action alternative would not utilize any active remedial technology for the ground water contaminant plume. The current interaction between the ground water plume and the surrounding environment would be allowed to continue. The site currently has a fence around the accessible perimeter.

In addition, ground water sampling and analysis would be conducted for the upper aquifer and lower aquifer to monitor any migration (horizontal and vertical) of the ground water plume.

8.1.2 Short-Term Effectiveness

The only potential impacts on workers would occur during ground water sampling events. Personnel involved with ground water sampling at the site would be required to comply with a site specific Health and Safety Plan to mitigate the potential impacts from worker exposure to ground water. Installation of shallow drinking water wells on-site would pose an immediate threat to the user.

8.1.3 Long-Term Effectiveness

The baseline risk assessment presented in the Remedial Investigation Report concluded that the site poses no unacceptable levels of risk to public health or environment associated with the migration of the ground water plume. This is due to the fact the site is abandoned and no wells have been installed immediately downgradient of the site in the contaminated portion of the aquifer. For the future use scenarios, there is a potential for unacceptable levels of exposure.

Groundwater quality monitoring is demonstrated and reliable for detecting the migration of the ground water plume. Potential migration pathways would be monitored by ground water sampling and analysis over time.

8.1.4 Reduction of Toxicity, Mobility, or Volume

Under the no action alternative, treatment of the ground water plume would not occur. Therefore, the toxicity, mobility, or volume of the ground water plume contaminants would not be reduced. The rate of dilution would be slow and the time required to reach an acceptable concentration level of contaminants in the ground water is unknown.

8.1.5 Implementability

The no action alternative is technically feasible and would employ common techniques for continued monitoring of the ground water plume. This alternative would not require any specific permits to implement.

8.1.6 Compliance with ARARs

Chemical Specific ARARs

Implementation of the no action alternative would not achieve compliance with the chemical specific ARARs (identified in Section 4.0) for ground water since the chemical compounds to remain in the ground water plume would exceed the cleanup criteria.

Location Specific ARARs

Because the no action alternative would potentially allow the ground water plume contaminants to migrate into the lower aquifer and/or discharge into Myers Creek, the following location specific ARARs would apply:

- o Clean Water Act, Section 404
- o Fish and Wildlife Coordination Act

It is not possible at this time to determine if the migration of the ground water plume contaminants into Myers Creek would comply with the above listed location specific ARARs.

Action Specific ARARs

The applicable requirements associated with the no action alternative would be the regulations governing work at the site for the ground water monitoring actions and fence maintenance. These regulations are as follows:

- OSHA - General Industry Standards (29 CFR 1910) which require respiratory protection and training for workers at the site;
- OSHA - Safety and Health Standards (29 CFR 1926) which dictate safety procedures for work activities; and
- OSHA - Record keeping, Reporting and Related Regulations (29 CFR 1904).

The ground water monitoring program and maintenance activities to be performed at the site would be designed to comply with the above listed action specific ARARs.

8.1.7 Overall Protection of Human Health and the Environment

The baseline risk assessment concluded that there appears to be concentrations of certain compounds in the ground water that may result in elevated levels of exposure if all the health protective assumptions of the future use scenarios are realized (i.e. future drinking water scenario). The site could pose an exposure threat if no action is taken.

The no action alternative would not comply with the chemical specific ARARs for groundwater. Activities under the no action alternative (ground water sampling, etc.) would comply with the identified action specific ARARs. It is not possible at this time to determine if any location specific ARARs would apply to the no action alternative because the ground water plume has not migrated to Myers Creek.

8.1.8 Cost

The costs associated with the no action alternative were assumed to include quarterly sampling of 16 monitoring wells (MW-1A, 1B, 3A, 3B, 7A, 7B, 7C, 8B, 9B, 9C, 10B, 11A, 11B, 12B, 12C, and 13B) for metals, volatile and semi-volatile organics for a period of thirty years. Reduction in the sampling frequency would be evaluated based on the results of the first five year's quarterly monitoring. In addition, there would be the cost of fence and roadway maintenance at the site. The total 30 year present worth cost of the no action alternative is $760,000. A breakdown of the estimated no action alternative cost is presented in the final draft Feasibility Study Report.

8.2 Ground Water Extraction and Treatment by Carbon Adsorption

8.2.1 Technical Description

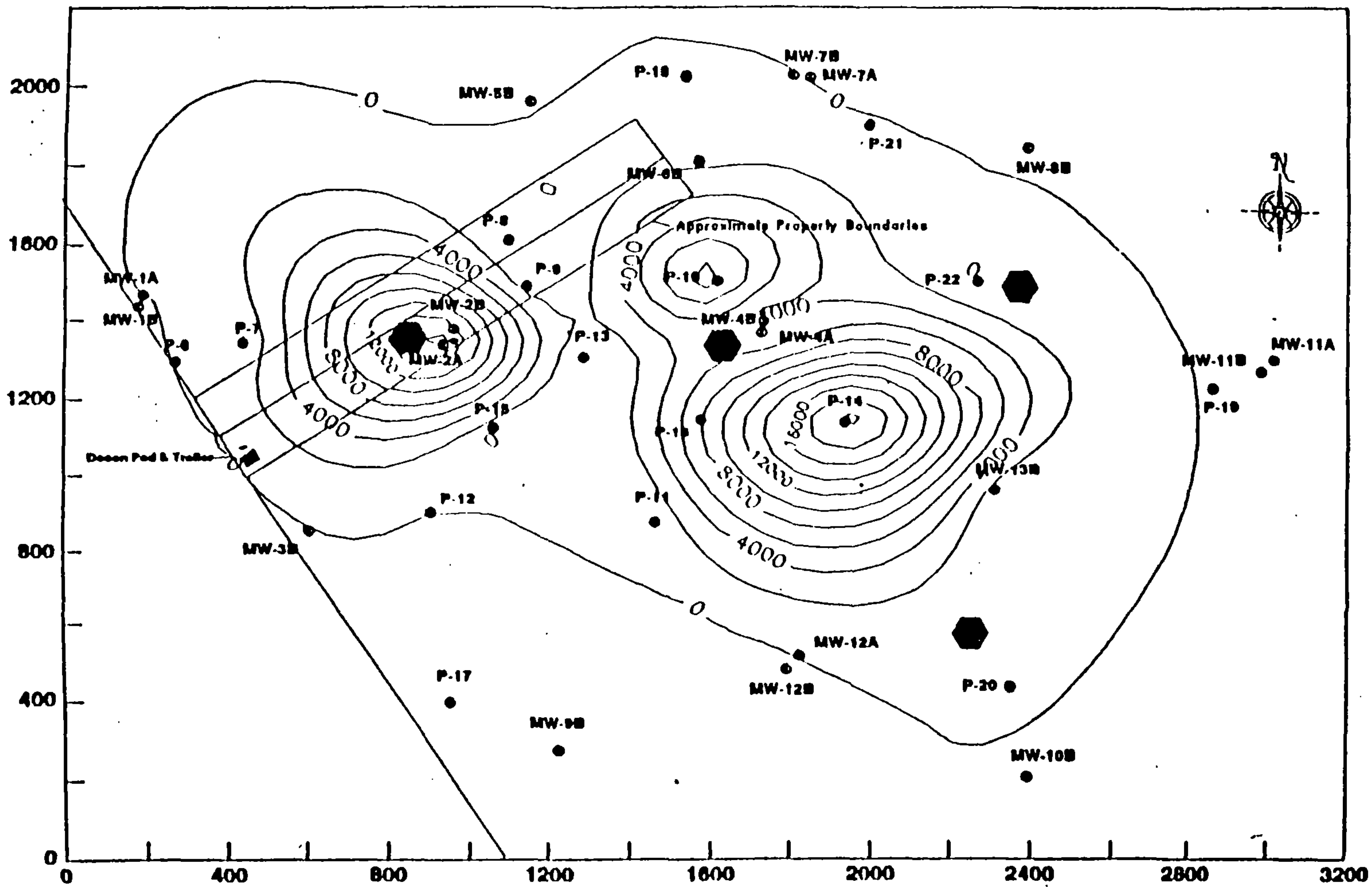
This alternative consists of a combination of ground water extraction and ground water treatment. Contaminated ground water would be extracted from the upper aquifer by installing recovery wells. Ground water treatment would be accomplished by means of carbon adsorption. A pretreatment process, such as precipitation or flocculation, may be necessary to remove metals from the ground water prior to treatment by carbon adsorption. The need for any such pretreatment process would be evaluated as part of the remedial design activities.

The ground water extraction system would consist of a combination of recovery wells located within the contaminant plume, and at the periphery of the plume. Recovery wells would be placed in the more highly contaminated zone of the plume to facilitate rapid removal of organic contaminants. The periphery wells would be used to limit expansion of the plume. Figure 6 shows potential location of the ground water extraction wells.

The actual extraction system including number, location, and configuration of wells would be developed during the remedial design. Pump tests and ground water modeling would be required to adequately define the extraction system. For the purpose of this analysis, four extraction wells and a total flow of 100 gpm were used. The pumping rate is a conservative value based on data from the RI. Carbon adsorption is a process by which the organic molecules in a waste stream are selectively attracted to the internal pores of the activated carbon granules. Adsorption is a surface attraction phenomenon which depends on the strength of the molecular attraction between adsorbent and adsorbent, electrokinetic charge, pH, and surface area. The waste stream would be usually contacted with the activated carbon by means of flow through a series of packed bed reactors.

Once the micropore surfaces of the carbon are saturated with organics, the carbon is "spent" and must either be replaced with virgin carbon or removed, thermally regenerated, and replaced. The time to reach "breakthrough" or exhaustion is the single most critical operating parameter. Carbon longevity balanced against influent concentrations governs operating economics.

The ground water from the extraction wells would be pumped into a surge tank before it is fed to the carbon adsorption system. The carbon adsorption system would consist of units which contain granular activated carbon (GAC) and operate in a downflow mode. The downflow fixed bed mode has been found to be generally most cost-effective and produces the lowest effluent concentrations relative to other carbon adsorber configurations. The units will be connected in parallel to provide increased hydraulic capacity.



LEGEND

CHEMICAL CONCENTRATION CONTOUR LINE (Concentration in parts per billion)

IT WELL (Installed 1986)

GOLDER WELL (Installed 1984)

GROUND WATER EXTRACTION WELL

SCALE: 1" = 435 ft

NOTE: CONTOUR INTERVAL = 2000 ppb

FIGURE 6

POTENTIAL LOCATIONS OF GROUND WATER EXTRACTION WELLS

INTERNATIONAL TECHNOLOGY CORPORATION

In order to minimize the carbon regeneration requirements, the carbon may be preceded by a pretreatment system (e.g. precipitation, filtration, etc.) to reduce suspended solids and inorganics such as iron. The carbon adsorption system evaluated for the Bluff Road Site would include two-dual bed carbon units with each bed containing 20,000 lbs. of GAC each. Four units would be needed to provide backup of other units during GAC regeneration. Field pilot plant testing would be performed to accurately predict performance, longevity and operating costs.

8.2.2 Short-Term Effectiveness

Carbon adsorption is a proven technology that if properly designed and operated, will remove the semi-volatile and volatile contaminants and not pose a human health hazard during operation. The system would be a closed system with no air emissions, therefore, there would be no risk through the inhalation pathway.

The potential short-term risks to site workers, public health and the environment are:

- Exposure to contaminated drilling fluids and soil during the installation of the ground water extraction wells.

- Release of contaminated water because of accidental spillage.

To mitigate risk posed by exposure to site constituents during well installations, workers would be required to comply with a site specific health and safety plan (including requirements for protective clothing). The potential environmental risk due to accidental spillage of ground water would be mitigated by proper process design. The treatment system design would incorporate process controls such as level switches and extraction pump shut-off controls.

8.2.3 Long-Term Effectiveness and Permanence

<u>Magnitude of Residual Risk:</u> The ground water treatment system would be designed such that all contaminants contained in extracted ground water would be reduced to levels at or below cleanup criteria.

The residuals resulting from operation of the treatment system would include filtered solids or settled solids and spent carbon. The carbon would be either regenerated or would be disposed by incineration or landfilling at an off-site RCRA treatment, storage, and disposal facility. The filtered or settled solids would be disposed in accordance with applicable regulations depending upon the hazardous characteristics exhibited by the solids.

8.2.4 Reduction in Toxicity, Mobility, or Volume

The pumping system would control the mobility of contaminants by extracting ground water within the upper aquifer and, therefore, stopping further migration. The contaminated water would be treated by the carbon adsorption unit, thereby reducing the toxicity of the ground water.

8.2.5 Implementability

Technical Feasibility: Carbon adsorption has been used extensively to treat contaminated ground water and has shown success in removing organic contaminants from ground water. Design and construction of the necessary treatment units would not pose a problem. Some equipment manufactures offer modular units that can be made to fit an individual application with minor modification. Precipitation and filtration have been well demonstrated for removal of inorganic compounds from aqueous streams. The equipment used in these processes is proven and reliable, thus downtime for repairs and maintenance should be minimal.

During operation of the treatment system, the effectiveness of the treatment process would be monitored by periodically analyzing contaminant concentrations in the treated water prior to discharge. Monitoring of ground water would be necessary during the operation of the system to ensure that the periphery of the plume is being treated.

Administrative Feasibility: The use of carbon adsorption would require compliance with U.S. EPA, U.S. Department of Transportation, and SCDHEC regulations regarding the transport and disposal of hazardous materials (spent carbon, filtered and settled solids from pretreatment system). In addition, disposal regulations and criteria must be met for discharge of the treated water.

Availability of Services and Materials: A range of vendors are available to supply all necessary units of the treatment systems. Because of the large number of equipment suppliers, availability and scheduling considerations would not be anticipated to pose problems.

8.2.6 Compliance with ARARs

Chemical-Specific: This alternative is designed to treat the ground water contaminants to attain the cleanup criteria. Chemical-specific ARARs for the Bluff Road Site were identified and discussed in Section 4.0. Several Federal and State regulations govern the quality, usage and discharge of ground water. Since ground water at the site has been classified as a drinking water source, all Federal and/or State drinking water standards would apply.

Location-Specific: The ground water extraction and treatment system would be located on the Bluff Road Site which is proximate to a wetland. Construction of this system as conceived may impact the wetland. The extent of the impact will be carefully considered during the remedial design. The impact to wetlands will be minimized and where it cannot be avoided the damage will be mitigated.

Action-Specific: This alternative would be designed to comply with action-specific ARARs. The action-specific ARARs for construction of the extraction and treatment systems, the treatment and subsequent disposal of the treated ground water and the management of treatment residuals were summarized in Section 4.0. Many RCRA Subtitle C requirements may apply because the site contains hazardous waste. RCRA Part 264 requirements may apply including standards for owners and operators of permitted hazardous waste facilities, preparedness and prevention, contingencies and emergency procedures, recordkeeping and reporting, and ground water monitoring. Federal OSHA worker health and safety requirements would be applicable to the construction and operation activities.

8.2.7 Overall Protection of Human Health and the Environment

This alternative would decrease the potential risk resulting from direct contact and ingestion of site ground water because the ground water would be treated to meet the clean-up criteria. This alternative can be implemented to meet identified ARARs.

8.2.8 Cost

The present worth cost of the Carbon Adsorption alternative, would be approximately $16,105,000.00. This cost would include a capital cost of $1,390,000.00, and present worth O & M cost of $14,715,000. A complete cost summary is included in the final draft Feasibility Study Report.

8.3 Ground Water Extraction and Treatment by Air Stripping

8.3.1 Technical Description

This alternative consists of a combination of ground water extraction and ground water treatment. Contaminated ground water would be extracted from the upper aquifer by installing recovery wells. Ground water treatment would be accomplished by means of air stripping towers, followed by a granular activated carbon (GAC) system. The more volatile constituents in ground water would be removed by air stripping, while semi-volatiles would be removed by the GAC system. A pretreatment process, such as precipitation or flocculation, may be necessary to remove metals from the ground water prior to treatment by air stripping and GAC. The need for any such pretreatment process would be evaluated as part of the remedial design activities.

The ground water extraction system would consist of a combination of recovery wells located within the contaminant plume, and at the periphery of the plume. Recovery wells would be placed in the more highly contaminated zone of the plume to facilitate rapid removal of organics. The periphery wells would be used to limit expansion of the plume.

The extraction system including number, location, and configuration of wells would be developed during the remedial design. Pump tests and ground water modeling would be required for the design of the extraction system. For the purpose of this analysis, four extraction wells and a total flow of 100 gpm were used. The pumping rate is a conservative value based on data from the RI.

The ground water from the extraction wells would be pumped into a surge tank before it is fed to the air stripping system. The air stripping system would consist of two towers arranged in series. Both towers would have 12 feet of packing material, 30 inches in diameter and use high air-to-water ratios. The use of two air strippers in series offers the following benefits over a single air stripper with comparable treatment capacity:

- If one of the air strippers would require maintenance, the other air stripper could continue to operate;

- Treatment capacity could be increased by running the strippers in parallel, should expansion of the extraction system become necessary.

Prior to treatment, the extracted ground water would contain the compounds identified in Tables 1 and 2 at the measured maximum concentration shown in column 1. Contaminant concentrations should steadily decrease from these levels. Actual treatment system influent composition would be defined during remedial design.

Air stripping can effectively remove most of these contaminants found in ground water at the Bluff Road Site (Golder, 1986). The exceptions would be 2-chlorophenol and phenols which would be removed by adsorption on the GAC.

After air stripping, the ground water would be pumped through cartridge filters and two carbon beds, also arranged in series. When the carbon in the first bed is spent, it would be replaced. A valve on the adsorption system would then be switched to reverse the order of the beds in the series. The beds are sized so that carbon would be expected to be replaced every 4 to 6 weeks. The system would be automated and designed for unattended operation. The final design of the ground water extraction system, air stripper, and GAC systems would require additional data collection prior to design.

As a result of ground water extraction and treatment, a discharge stream of treated ground water would be generated. As a best engineering judgement based on available data, the volumetric flow of the discharge stream is assumed to be 144,000 gallons per day based on 100 gpm ground water recovery system operating 24 hours per day. More precise ground water withdrawal and discharge values would be determined as part of the remedial design. Further discussion of effluent discharge alternatives is presented in Section 5.4.

8.3.2 Short-Term Effectiveness

Potential short-term risks to public health and the environment during the implementation of this alternative include the potential inhalation of organic vapors released from the air stripping process. An air dispersion model was used to calculate the ambient air quality resulting from the organic vapor emissions from the air stripper after vapor phase carbon adsorption treatment. The air dispersion modeling was conducted in accordance with applicable EPA guidance documents. Based on the results of the air dispersion model, a health evaluation was conducted to determine the potential risk, if any, to public health from the inhalation of organic vapors. The air dispersion model results and associated risk health evaluation are presented in Appendix C of the final draft Feasibility Study Report.

The air dispersion modeling for this alternative identified the downwind location where the maximum one-hour concentrations would be expected and the location where the maximum annual concentrations would be expected. The ambient air concentrations for the chemicals of concern at these locations determined by the air dispersion model were used to determine the potential risk, if any, to public health from the inhalation of organic vapors generated by the air stripping process.

The public health evaluation identified the following potential receptor groups which may experience maximum exposures to airborne contaminants:

1. Remediation workers in the immediate vicinity of the air stripper who might be exposed to short-term (one hour) peak concentrations;

2. Remediation workers present at the site for the duration of the remedial action (16 years) who might be exposed to airborne contaminants; and

3. Off-site residents who might be exposed to airborne contaminants for the duration of the remedial action (16 years).

For the first receptor group (remediation workers exposed for one hour to peak concentrations) the maximum predicted one-hour concentrations for each chemical of concern were compared to the Threshold Limit Values for those chemicals. Threshold Limit Values have been developed by the American Conference of Governmental and Industrial Hygienists (ACGIH) and are occupational exposure criteria that represent airborne concentrations of substances to which nearly all workers may be repeatedly exposed without adverse effects. The maximum predicted one-hour concentrations are far below the threshold limit values for occupational exposure, therefore, it is concluded that there is no danger of acute toxicity due to exposure to short-term emissions from the air stripper system.

For the second receptor group (remediation workers present at the site for the duration of the remedial action), the total cancer risk associated with exposure to maximum concentrations of all the chemicals of concern is estimated at 5.9×10^{-9} under the conditions of this scenario presented in Appendix C of the revised draft Feasibility Study Report. The total hazard index for non-carcinogenic effects is 3.5×10^{-7} which is below the 1.0 hazard index value which indicates a potential hazard.

To represent the third receptor group (off-site residents who might be exposed for the duration of the remedial action), a child was used because of higher inhalation rate to body weight ratio, thus resulting in a worst case exposure scenario. Forthis receptor group, the total estimated cancer risk associated with exposure to maximum concentrations of all the chemicals of concern is 1.1×10^{-9}. The total hazard index for non-carcinogenic effects is 2.7×10^{-7}, which is far below the 1.0 hazard index value which indicates a potential hazard.

Two other potential short-term risks to site workers and the environment are:

- o Exposure to drilling fluids and soil during the installation of the ground water extraction wells.
- o Release of contaminated water because of accidental spillage.

To mitigate risk posed by exposure to site constituents during well installations, workers would be required to comply with a site specific health and safety plan (including requirements for protective clothing). The potential environmental risk due to accidental spillage of ground water would be mitigated by proper process design. The treatment system design would incorporate process controls such as level switches and extraction pump shut-off controls.

8.3.3 Long Term Effectiveness

Magnitude of Residual Risks

This ground water alternative would be implemented until the ground water concentrations are reduced to the cleanup criteria. To determine the magnitude of residual risk at the site after the ground water remedial action is complete, the drinking water scenario was reevaluated based on the cleanup criteria. The results of the post remediation risk assessment for ground water ingestion is represented in Appendix B of the final draft Feasibility Study report.
The residuals resulting from operation of the treatment system would include filtered solids and spent carbon. The filtered solids and the carbon would be either regenerated at a permitted facility or would be disposed of by incineration or landfilling at a RCRA treatment storage and disposal facility.

8.3.4 Reduction in Toxicity, Mobility, and Volume

The pumping system would control the mobility of contaminants present by extracting ground water within the upper aquifer. Contaminated water would be treated by the air stripping and carbon adsorption units, thereby reducing the toxicity of the ground water.

8.3.5 Implementability

Technical Feasibility: Both air stripping and carbon adsorption have been used extensively at CERCLA sites and have been successful in removing organic constituents from ground water. Design and construction of the necessary treatment units would not pose a problem. Some equipment manufacturers offer moduler units that can be made to fit an individual application with minor modification.

During operation of the treatment system, the effectiveness of the treatment process would be monitored by periodically analyzing constituent concentrations of the treated water prior to discharge.

This alternative is designed to treat the ground water contaminants to attain cleanup criteria. Chemical-specific ARARs were identified and discussed in Section 4.0. Several Federal and State regulations govern the quality, usage and discharge of ground water.

Location-Specific: The ground water extraction and treatment system would be located on the Bluff Road Site which is proximate to a wetland. Construction of this system as conceived may impact the wetland. The extent of the impact will be carefully considered during the remedial design. The impact to wetlands will be minimized and where it cannot be avoided the damage will be mitigated.

Action-Specific: This alternative would be designed to comply with action-specific ARARs. The action-specific ARARs for construction of the extraction and treatment systems, the treatment and subsequent disposal of the treated ground water, and the management of treatment residuals are summarized in Section 4.0. Many RCRA Subtitle C requirements would apply because the Bluff Road Site contains hazardous waste. RCRA Part 264 requirements that may apply include standards for owners and operators of permitted hazardous waste facilities, preparedness and prevention, contingency plan and emergency procedures, recordkeeping and reporting, and ground water monitoring. Federal OSHA worker health and safety requirements would be applicable to the construction and operation activities.

8.3.7 Overall Protection of Human Health and Environment

This alternative would decrease the potential risks resulting from direct contact and ingestion of site ground water because the ground water would be treated to meet the health protective cleanup criteria. This alternative can be implemented to meet the identified ARARs.

8.3.8 Cost

The present worth cost for the Air Stripping alternative, would be approximately $4,339,500. This cost would include a capital cost of $1,013,000, and estimated annual O&M expenditures of $306,875. A complete cost summary is included in the final draft Feasibility Study Report.

8.4 Effluent Discharge Alternatives:

Effluent from either the air stripper or the GAC will require discharge of treated water to some location. The alternatives that have been evaluated as part of completion of the RI/FS include the following:

- Injection into the subsurface
- Discharge to Myers Creek
- Discharge to the Congaree River
- Spray irrigation into the wetland area

8.4.1 Subsurface Injection of Effluent

Infiltration galleries are a proven and viable alternative for effluent discharge. The process involves the use of drains, trenches and/or piping to introduce the treated ground water into the vadose zone where it is allowed to percolate into the soil. There are two basic types of infiltration gallaries, horizontal and vertical. The horizontal system uses trenches lined with gravel or perforated piping to introduce the ground water into the vadose zone. Vertical infiltration uses vertical perforated piping with appropriate packing materials to allow radial infiltration over the depth of the vadose zone. Due to the clay content of the soils in the vadose zone, infiltration galleries may not operate effectively as a discharge alternative during extended wet periods.

Discharge limitations for subsurface infiltration of the treated ground water will be the cleanup criteria. This effluent discharge option would establish the discharge design requirements for the ground water treatment system.

The effectiveness of this method is dependent on vadose zone acceptance of the treated water. A preliminary assessment of infiltration rates based on aquifer and near aquifer vadose zone soil classification indicates that this technology would be feasible for the Bluff Road Site.

Percolation testing must be performed to determine permissible application rates of treated ground water and to establish the most appropriate process alternative (i.e., horizontal or vertical). The infiltration gallery must be located so that recharge to the aquifer does not interfere with the performance of the extraction system (hydraulic control). These considerations can be addressed adequately in design. The basis for conceptual cost evaluation is a horizontal infiltration galleny. The estimated infiltration area required was determined using the lowest permeability determined by performing slug tests on shallow wells in the upper aquifer (9.27 X 10^{-4} cm/sec). This equates to an estimated permissible application rate of 50 gallons/day/ft^2. With an estimated flow rate of 100 gpm, approximately 3000 ft. of infiltration trenches would be required for horizontal infiltration. The infiltration trenches would be distributed over an area of approximately 15,000 square feet. This is based on a trench width of approximately 2 feet and trench spacing of approximately 7.5 feet (center to center). Again, permissible application rates would have to be confirmed during remedial design.

The present worth cost for the infiltration gallery effluent discharge alternative would be approximately $165,484. This cost would include a capital cost of $117,656, and estimated annual O&M expenditures of $4,412. A complete cost summary is included in the final draft Feasibility Study Report.

8.4.2. Discharge to Myers Creek

The maximum allowable chemical concentrations to a receiving Class A stream such as Myers Creek or the Congaree River (see Section 5.4.3. below) would be based on Ambient Water Quality Criteria (where available) or RFSs.

The volumetric flow of the discharge stream is assumed to be 144,000 gallons per day. The estimated average daily volumetric flow in Myers Creek is 154,000 gallons per day (IT Corp., 1989).

8.4.3 Discharge to Congaree River

The Congaree River is classified the same as Myers Creek (Class A). Maximum allowable chemical concentrations in the treatment system discharge would be calculated as described in Section 5.3.4.3. of the final draft Feasibility Study Report.

Discharge of effluent to the Congaree River would require an extensive overland piping system to transport the water approximately 2 to 3 miles to the river. This would also require access agreements and easements.

As with Myers Creek, the impacts of the discharge on river levels (e.g. flood levels) should be evaluated as part of the remedial design.

8.4.4 Spray Irrigation

Spray irrigation is a procedure by which effluent is discharged through a surface spray system. Spray irrigation is limited to those times when the ground is not frozen.

This alternative would be further evaluated during remedial design if it appears that the ground water recovery network will impact the water levels in the wetland area. The spray irrigation design to recharge the wetland and offset the impacts of ground water withdrawal would be difficult due to poor percolation in off-site surface soils and potential flooding resulting from sheet flow to down gradient areas. Feasibility of this alternative is considered marginal.

DETAILED ANALYSIS OF SOIL REMEDIATION ALTERNATIVES

8.5 No Action Alternative

The no action alternative serves as a baseline for comparison of the overall effectiveness of each soil remediation alternative.

8.5.1 Technical Description

The no action alternative would not utilize any active remedial technology for the site soils that are currently above the target cleanup levels. The current interaction between the site soils and the surrounding environment would be allowed to continue.

According to the Remedial Investigation Report, the principle environmental and human health threat posed by the site soils is the effect the soils have on the ground water plume due to leaching of soil contaminants.

8.5.2 Short Term Effectiveness

Because remedial action for the soils would not be implemented, there would be no short-term environmental impacts or risks from activities associated with this alternative.

8.5.3 Long-Term Effectiveness

The baseline risk assessment presented in the Remedial Investigation Report concluded that the surface soils do not pose an unacceptable risk to human health or the environment. However, the more highly contaminated subsurface soils continue to leach contaminants into the ground water below the site at unacceptable concentrations. The baseline risk assessment concluded that there are concentrations of compounds in the ground water that could result in exposure if the water were to be used as drinking water source.

8.5.4 Reduction of Toxicity, Mobility, or Volume

The toxicity, mobility, or volume of the contaminants present in the soils would not be reduced under the no action alternative because no treatment technologies would be employed.

8.5.5. Implementability

The no action alternative is technically feasible. This alternative would not require any special permits to implement.

8.5.6 Compliance with ARARs

Chemical Specific ARARs

There are currently no ARARs for soils. However, because the contaminated site soils are a source that will further degrade ground water quality, a soil/water partitioning model (available for review in the final draft Feasibility Study Report) was used to calculate cleanup criteria for the soils. The no action alternative would not meet the calculated cleanup criteria for soils.

Location Specific ARARs

As stated in the detailed analysis for the no action ground water alternative, the following potential ARARs would apply if the ground water plume contaminants reached Myers Creek:

- o Clean Water Act, Section 404
- o Fish and Wildlife Coordination Act

Under the no action soil alternative, these ARARs may potentially apply if contaminants present in the soils leach into the ground water plume and subsequently migrate into Myers Creek.

Action Specific ARARs

There are no action specific ARARs for the no action soil remediation alternative.

8.5.7 Overall Protection of Human Health and the Environment

The no action alternative for soils may increase the potential risks associated with the ground water plume by contaminant leaching if the ground water plume is not remedied. There are no direct risks resulting from the no action soil remediation alternative. The no action alternative would not meet the calculated cleanup criteria for soils.

8.5.8 Cost

There are no capital or operational and maintenance costs associated with the no action alternative. The cost of monitoring the effect of site soils on the ground water plume are included in the cost for ground water quality monitoring under the ground water remedial alternatives.

8.6. In-Situ Soil Vacuum Extraction (Soil Venting)

8.6.1 Technology Description

Soil vacuum extraction as proposed herein is an in-situ treatment process used to clean up soils that contain volatile and some semi-volatile organic compounds. The process utilizes extraction wells to induce a vacuum on subsurface soils. The subsurface vacuum propagates laterally, causing in-situ volatilization of compounds that are adsorbed to soils. Vaporized compounds and subsurface air migrate rapidly to extraction wells, essentially air stripping the soils in-place.

A vacuum extraction system consists of a network of air withdrawal (or vacuum) wells installed in the unsaturated zone. A pump and manifold system of PVC pipes is used for applying a vacuum on the air wells which feed an in-line water removal system, and an in-line vapor phase carbon adsorption system for VOC removal. Vacuum wells can either be installed vertically to the full depth of the contaminated unsaturated zone or installed horizontally within the contaminated unsaturated zone. If horizontal vacuum wells are utilized, the wells would require construction by trenching to mid-depth in the soil column. For the purposes of this evaluation, vertical wells were selected due to the depth of the soil strata requiring remediation, geotechnical conditions, and the depth to groundwater.

Once the well system has been installed and the vacuum becomes fully established in the soil column, VOCs would be drawn out of the soil and through the vacuum wells. In all soil venting operations, the daily VOC removal rates eventually decrease as volatiles are recovered from the soil. This occurs since volatile recovery decreases the VOC concentration in the soil, and consequently reduces the diffusion rate of volatiles from the soil. Volatiles in the air stream are removed by the carbon adsorption system or destroyed by fume incineration, after which the cleaned air is discharged to the atmosphere.

The application of soil venting to the unsaturated zone remediation is a multi-step process. Specifically, full-scale vacuum extraction systems are designed with the aid of laboratory and pilot-scale VOC stripping tests. This would be performed as part of remedial design.

8.6.2 Short-Term Effectiveness

An air dispersion model was used to calculate the ambient air quality resulting from the organic vapor emissions from the soil venting system after vapor phase carbon adsorption treatment. The air dispersion modeling was conducted in accordance with applicable EPA guidance documents. Based on the results of the air dispersion model, a health evaluation was conducted to determine the potential risks, if any, to public health from inhalation of organic vapors. The air dispersion model results and associated health evaluations are presented in Appendix E of the revised draft Feasibility Study Report.

The air dispersion modeling for this alternative identified the downwind location where the maximum one-hour concentrations would be expected and the location where the maximum annual concentrations would be expected. The ambient air concentrations for the chemicals of concern at these locations determine the potential risk, if any, to public health from the inhalation of organic vapors generated by the in-situ soil venting process.

The public health evaluation identified the following potential receptor groups which may experience maximum exposures to airborne contaminants:

1. Remediation workers in the immediate vicinity of the soil venting system who might be exposed to short-term (one-hour) peak concentrations;

2. Remediation workers present at the site for the duration of the remedial action (18 months) who might be exposed to airborne contaminants; and

3. Off-site residents who might be exposed to airborne contaminants for the duration of the remedial action (18 months).

For the first receptor group (remediation workers exposed for one hour to peak concentrations) the maximum predicted one-hour concentration for each chemical of concern as compared to the Threshold Limit Values that have been developed by the American Conference of Governmental and Industrial Hygienists (ACGIH) and areoccupational exposure criteria that represent airborne concentrations of substances to which nearly all workers may be repeatedly exposed without adverse effects. The maximum predicted one-hour concentrations are far below the Threshold Limit Values for occupational exposure, therefore, it is concluded that there is no danger of acute toxicity due to exposure to short-term emissions from the in-situ soil venting system.

For the second receptor group (remediation workers present at the site for the duration of the remedial action), the total cancer risk associated with exposure to maximum concentrations of all the chemicals of concern is estimated at 1.5×10^{-10} under the conditions of this scenario presented in Appendix E of the revised draft Feasibility Study Report. The total hazard index for non-carcinogenic effects is 1.7×10^{-9} which is far below the 1.0 hazard index value which indicates a potential hazard.

To represent the third receptor group (off-site residents who might be exposed for the duration of the remedial action), a child was used because of higher inhalation rate to body weight ratio, thus resulting in a worst case exposure scenario. For this receptor group, the total estimated cancer risk associated with exposure to maximum concentrations of all the chemicals of concern is 2.1 X 10^{-9}. The total hazard for non-carcinogenic effects is 2.3 X 10^{-9} which is far below the 1.0 hazard index value which indicates a potential hazard.

The potential short-term risks to site workers would be the exposure to drilling fluids and soil during the installation of the soil venting extraction wells. To mitigate these risks, workers would be required to comply with a site-specific health and safety plan (including provisions for protective equipment).

8.6.3 Long-Term Effectiveness

Magnitude of Residual Risk

The soil venting system would be designed and operated such that those contaminants in the soil which are considered to be a source of ground water contamination would be reduced to the cleanup criteria identified by the soil partitioning model. Therefore, the soils would no longer be a source contributing to the ground water plume and the remedial action objective for soil would be met.

Adequacy and Reliability of Controls

The residues resulting from the treatment system would include spent carbon used for vapor phase adsorption. This carbon would contain organic compounds and would be disposed in a RCRA landfill or would be incinerated. The regeneration of spent carbon would also be a viable residuals management alternative. The adequacy and reliability of residuals management would be assured by using a permitted regeneration facility or a RCRA treatment, storage, and disposal facility.

8.6.4 Reduction of Toxicity, Mobility, and Volume

Soil vacuum extraction would significantly reduce the volume of volatile organic contaminants in the soil. Results of the plant test at the site indicated significant quantities of semi-volatile organic compounds will be removed, reducing to volume of these contaminants in the soil.

8.6.5 Implementability

Technical Feasibility

In-situ soil vacuum extraction is a proven technology and has been applied in both pilot test and full scale remediation programs for stripping volatile organic and a limited number of semi-volatile compounds from unsaturated soils and bedrock. The organic vapor treatment facilities (i.e. vapor phase carbon adsorption or fume incineration) have also been successfully implemented. Golder (1986) conducted laboratory testing on contaminated soils which showed that the affected site soils are amenable to air stripping. Pilot tests indicate that some semi-volatile compound removal does occur during the vacuum process. During operation, the effectiveness of the system would be monitored by periodically analyzing contaminant concentration of the following:

- o Treated Soil
- o Untreated Vapor Entering the System
- o Treated Vapor

Administrative Feasibility:

This alternative would require compliance with EPA, U.S. Department of Transportation, and SCDHEC regulations regarding transportation and disposal of hazardous materials (i.e. spent carbon). SCDHEC may require permits for the vapor discharge.

8.6.6 Compliance with ARARs

Chemical Specific: Implementation of this alternative would achieve the cleanup criteria for volatile organic compounds in the soils as identified in the soil partitioning model. It is uncertain as to whether or not the technology would achieve cleanup criteria for the semi-volatiles, however, the pilot test indicates semi-volatile organic compounds may be removed by this process.

Action-Specific: The alternative would be designed, constructed and operated to comply with action-specific ARARs. The action-specific ARARs for construction of the extraction and treatment system, the treatment and disposal of treated vapor, and disposal of residuals (spent carbon) are summarized in the revised draft Feasibility Study Report (Table 3-5). Federal OSHA worker health and safety requirements would be applicable to the construction and operation activities and would be compiled with by adhering to an approved work plan and health and safety plan. Many RCRA requirements may apply because the Bluff Road Site contains hazardous waste. RCRA Part 264 requirements that may apply include standards for owners and operators of permitted hazardous waste facilities, preparedness and prevention, contingency plan and emergency procedures, recordkeeping and reporting.

It is anticipated that this alternative would comply with applicable portions of the Clean Air Act and the South Carolina Pollution Control Act.

8.6.7 Overall Protection of Human Health and the Environment

This alternative would decrease the potential risks associated with the migration of organic contaminants into ground water from the soils.

8.6.8 Cost

The estimated total cost for the soil vacuum extraction system with vapor phase carbon adsorption would be approximately $1,070,000. This capital cost includes the anticipated O&M expenditures since this remedial action is not expected to last over 2 years.

Capital cost would include construction of the soil vapor extraction system, vapor treatment system, and all associated piping/mechanical facilities.

8.7 High Temperature Incineration

8.7.1 Technical Description

This alternative consists of excavation and treatment of the contaminated soils on-site using high temperature incineration. This treatment technology has been proven effective at treating soils that contain elevated levels of organic contaminants. Prior to initiation of this remedial alternative, supplementary soil sampling would be performed to adequately delineate the volume of soil present above the target clean-up levels. Approximately 23,000 to 45,000 cubic yards of soil at the site is estimated to be above the cleanup criteria.

Process Description

For the development of this alternative, the representative process option for high temperature incineration is the commercially available transportable rotary kiln incineration system.

This system uses a rotating refractory lined kiln to treat solids, soils, sludges and liquid wastes. The kiln is approximately 8 feet in diameter and 60 feet long. The soils would be heated to 1200^{o}F to 1500^{o}F by 60 mm BTU per hour oil fired fuel burners. The rotating kiln serves to mix, convey, and agitate the contaminated soil. After processing, the treated soil would be discharged from the kiln into a pug mill where it is moisturized by the addition of water to reduce dusting.

During incineration, combustion gas leaves the kiln at 1400°F to 1600°F and contains partially combusted organics, acid gases, entrained soil particles, and ash particulate. The combustion gas would pass through a hot cyclone for removal of relatively large particulates and would flow into a secondary combustion chamber (SCC). The SCC completes the combustion of the organic vapors from the soil by exposing the remaining organic vapors, carbon monoxide (CO) and carbonaceous particulates to temperatures in the range of 1800°F to 2200°. The SCC is sized for a combustion gas residence time of at least two seconds at 2200°F.

For the organics present in the site soils, a temperature of 1800°F should be adequate to produce destruction and removal efficiencies (DREs) of at least 99.99%. The operational temperature necessary to achieve DREs of at least 99.99% would be determined during a pre-operational trial burn. The SCC will be fired by a 40 mm BTU per hour burner.

The combustion gas would leave the SCC at approximately 1800°F and enter the air pollution control (APC) system. The APC system would include an evaporative cooler, a baghouse, and a packed bed alkaline scrubbing unit.

The purge stream from the packed bed would be used for the evaporative cooler. Salts such as sodium chloride and sodium sulfate, which are formed in the packed bed, would be evaporated in the evaporative cooler and removed by a fabric filter. The combustion gas would leave the evaporative cooler at 300°F to 350°F, and enter the fabric filter where most of the remaining particulate would be removed. The combustion gas would then enter the packed bed for alkaline scrubbing removal of most of the acid gases. The combustion gas would exit the packed bed at approximately 185°F and enter the induced draft (ID) fan. The ID fan pulls the combustion gas through the entire incineration system and exhausts the combustion gas to the stack and out to the atmosphere. Stack emissions would be continuously monitored for carbon monoxide, oxygen, and the combustion gas velocity to verify compliance with Federal and State Regulations. An automatic waste feed cutoff system would be tied into various incinerator monitoring parameters such as temperature, carbon monoxide and waste feed rates in accordance with 40 CFR 264 Subpart O regulations and appropriate guidance documents. The system requires an area of two to three acres. The soil would be processed at a rate of approximately 20 tons per hour (for soil with a moisture content of about 20 percent). At an operating factor of about 80%, 190 days of continuous operation would be required to treat 72,900 tons (45,000 cubic yards) of soil. Mobilization, demobilization and decontamination of the incineration equipment will take about 60 days. Therefore implementation of on-site high temperature incineration is expected to take less than one year from the initial mobilization and start-up.

Site Preparation and Preprocessing

Prior to excavation, the site would be cleared of vegetation. Any existing foundations or concrete pads would be decontaminated and disposed accordingly.

Excavation and teatment would proceed in stages. The excavation rate should match the treatment rate in order to minimize the storage space required. Water spray would be used for dust control, if necessary. Vapor suppression foams or some other form of emission control would be used if high levels of organic vapors in the breathing zone are detected during excavation. The excavated soil would be preprocessed in a tent structure of pole-barn construction and placed in containers or tanks as required by the RCRA definition of storage. The storage space should be sized for adequate processing capacity to assure continuous operation during inclement weather.

The soil would be removed from the storage area in the tent using a covered belt conveying system and would drop into a hopper over a scalping screen or shedder to remove oversized (greater than 2-inch) material and debris. The sorted material would then be transported by an enclosed drag conveyor to a hopper that directly feeds the incinerator. Rocks and other large objects would be screened and removed from the feed system, stockpiled on a pad, and decontaminated by steam cleaning. These materials would then be used as backfill on-site, after confirmatory sampling to assure adequate decontamination.

Residuals Treatment

Purge water from the scrubber would be recycled to the evaporative cooler where it would be evaporated. The salts and suspended solids contained in the purge water would be captured in the fabric filter.

Solids from the cyclone and fabric filter would be mixed with the treated soil after analytical testing verifies the absence of organic compounds and metals. If the solids are unacceptable for mixing with the soil, they would be stabilized and disposed off-site.

The treated soils would also be analyzed for the presence of organic compounds and TCLP Metals. If the treated soils fail to meet these criteria, the soils would be stabilized prior to backfilling.

8.7.2 Short-Term Effectiveness

Potential risks to public health and the environment are associated with the excavation and treatment of the contaminated soils.

Air pollution control systems would be an integral part of the on-site high temperature incinerator to limit air emissions to within the regulatory requirements. Stack and site perimeter monitoring will ensure that the discharge limits are not exceeded. An air dispersion model was used to calculate the ambient air quality resulting from the anticipated incineration air emissions (after treatment with air pollution control systems). The air dispersion model was conducted in accordance with applicable EPA guidance documents. Based on the results of the air dispersion model, a health evaluation was conducted to determine the potential risks, if any, to public health from the inhalation of emitted compounds. The air dispersion model results (including associated input data calculations) and the health evaluations are presented in Appendix F of the revised draft Feasibility Study Report.

The air dispersion modeling for this alternative identified the downwind location where the maximum one-hour concentrations would be expected and the location where the maximum annual concentrations would be expected. The ambient air concentrations for the chemicals of concern at these locations determined by the air dispersion model were used to determine the potential risk, if any, to public health from the inhalation of emitted compounds generated by the high temperature incineration process.

The public health evaluation identified the following potential receptor groups which may experience maximum exposures to airborne contaminants;

1. Remediation workers in the immediate vicinity of the incinerator who might be exposed to short-term (one hour) peak concentrations;

2. Remediation workers present at the site for the duration of the remedial action (200 days) who might be exposed to airborne contaminants; and

3. Off-site residents who might be exposed to air-borne contaminants for the duration of the remedial action. (200 days)

For the first receptor group (remediation workers exposed for one hour to peak concentrations) the maximum predicted one-hour concentrations for each chemical of concern were compared to the Threshold Limit values for those chemicals. Threshold Limit Values have been developed by the American Conference of Governmental and Industrial Hygienist (ACGIH) and are occupational exposure criteria that represent airborne concentrations of substances to which nearly all workers may be repeatedly exposed without adverse effects. The maximum predicted one-hour concentrations are far below the Threshold Limit Values for occupational exposure, therefore, it is concluded that there is no danger of acute toxicity due to exposure to short-term emissions from the high temperature incinerator.

For the second receptor group (remediation workers present at the site for the duration of the remedial action), the total cancer risk associated with exposure to maximum concentrations of all the chemicals of concern is estimated at 1.7×10^{-7} under the conditions of this scenario presented in the revised draft Feasibility Study Report. The total hazard index for non-carcinogenic effects is 4.9×10^{-4} which is far below the 1.0 hazard index value which indicates a potential hazard.

To represent the third receptor group (off-site residents who might be exposed for the duration of the remedial action), a child was used because of higher inhalation rate to body weight ratio, thus resulting in a worst case exposure scenario. For this receptor group, the total estimated cancer risk associated with exposure to maximum concentrations of all the chemicals of concern is 2.2×10^{-7}. The total hazard index for non-carcinogenic effects is 6.6×10^{-4} which is far below the 1.0 hazard index value which indicates a potential hazard.

Short term emissions of dust and organic vapors may occur during the excavation and pretreatment activities. These emissions may be mitigated by the proper use of water sprays, foams, and vapor control techniques Downwind air monitoring for organics will be used to detect any off-site air emissions. In addition, risks to workers may occur because of contaminant volatilization during waste excavation, and at the processing and stockpile areas. Workers involved with the waste excavation and processing activities may also be exposed to the additional risks associated with dermal contact with contaminated soils. Therefore, all workers would be required to wear appropriate protective equipment, as specified in the site specific health and safety plan.

8.7.3 Long-Term Effectiveness

Magnitude of Residual Risks The treated soil would be tested for leaching potential and organic compounds to ensure treatment to established clean-up levels is achieved. Treatability testing would be conducted to determine the expected organic and metal concentrations after treatment.

Adequacy of Controls Data available from vendors indicates an organic removal rate of 99.99 percent or greater is achievable by high temperature incineration. Therefore, it is expected that the clean-up criteria can be achieved by this technology.

Reliability of Controls The removal of organic compounds from the soil followed by incineration of the vapors is a permanent process.

8.7.4 Reduction in Mobility, Toxicity, or Volume

The thermal destruction of organic compounds from the soils provides the multiple benefit of reducing the toxicity, mobility, and volume of the organic compounds present in the soil. Destruction of at least 99.99% of the organics vaporized from the soil would be expected. The treatment process is irreversible and the treated soil is expected to meet the soil remediation goals. The volume of soil may be less than was processed in the system.

8.7.5 Implementability

Technical Feasibility The high temperature rotary kiln incineration process has been used in many projects to treat organic compounds present in soil. The soils present at these sites were treated to meet the respective remedial action objectives and the incineration processes were conducted to comply with the applicable ARARs.

Administrative Feasibility Acquisition of regulatory permits may not be required. However, the documentation for technical permit requirements would be provided to EPA for approval prior to implementation of any remedial activities.

Currently, three vendors are known to have a total of five mobile rotary incineration systems in this size category. Treatment units are available that would have sufficient capacity to perform soils treatment at the site within a reasonable period of time. Advanced scheduling would be required to ensure that a mobile incineration system is available.

8.7.6 Compliance with ARARs

Chemical Specific ARARs

This alternative is expected to meet the calculated clean-up criteria for soils. The site soils above the cleanup criteria would be excavated and treated by high temperature incineration to those concentrations.

Action Specific ARARs

Action specific ARARs for this alternative apply to the excavation of contaminated soils, monitoring requirements, and operation of a thermal treatment unit. Workers and worker activities that would occur during the implementation of this alternative must comply with the OSHA requirements for training, safety equipment and procedures, monitoring, recordkeeping, and reporting. In addition, the RCRA requirements for preparedness and prevention, contingency plans, and emergency procedures would also apply to this alternative. Compliance with the above mentioned ARARs would be achieved by following an EPA approved work plan and a site-specific health and safety plan.

The RCRA standards for permitted hazardous waste facilities, including performance standards (40 CFR 264), may apply to the high temperature incineration unit. To achieve compliance with these ARARs, the unit used would be designed, constructed, and operated in accordance with the provisions contained in the RCRA hazardous waste facility regulations.

This alternative would result in air emissions. The applicable requirements for air emissions would be the Prevention and Significant Deterioration (PSD) air emission provision contained in the Clean Air Act and the requirements contained in the South Carolina Pollution Control Act. It is anticipated that the treatment system will not exceed the PSD limits and would comply with South Carolina Pollution Control Act requirements for air emissions. The action specific ARAR of the RCRA Land Disposal Restrictions would be met if the cleanup criteria in Tables 3-3 and 3-4 are met.

8.7.7 <u>Overall Protection of Human Health and the Environment</u>

This alternative would destroy the organic contaminants present in the soils thus reducing the toxicity, mobility, and volume of the contaminants. Therefore, this alternative would meet the remedial action objectives for soil. Protection of human health and the environment would be achieved by meeting the remedial objectives and by complying with the identified ARARs.

8.7.8 <u>Cost</u>

The capital cost associated with this alternative include site preparation, incineration unit mobilization and demobilization, pilot testing, the construction of support facilities, soil excavation and treatment, site restoration, and a mobile laboratory. Due to the short implementation period associated with this alternative the operation and maintenance cost for this alternative are incorporated in the capital cost. Therefore, a present worth analysis has not been performed for this alternative. The estimated cost of this alternative (based on 45,000 cubic yard of soil) is $28,260,000. A detailed breakdown of the estimated costs associated with this alternative are presented in the final draft Feasibility Study Report.

8.8. <u>Low Temperature Thermal Desorption</u>

8.8.1 <u>Technical Description</u>

This alternative consists of excavating the site soils and treating the soils on-site using low temperature thermal desorption. This treatment technology has been proven effective at treating soils that contain elevated levels of organic contaminants. Approximately 16,000 to 45,000 cubic yards of soil at the site is estimated to be above the target clean-up levels. Prior to initiation of this remedial alternative, supplementary soil sampling would be performed to adequately delineate the volume of soil present above these levels.

Process Description

For the development of this alternative, the representative process option for low temperature thermal desorption is the commercially available modified asphalt kiln. This system uses a rotating kiln with soil lifters inside the kiln to mechanically agitate the soil and improve heat transfer. The kiln is approximately 8 feet in diameter and 40 feet long. The soil would be heated to approximately 600^{O}F by a 50mm BTU per hour fuel oil burner firing in the kiln.

The rotating kiln and lifters serve to mix, convey, and agitate the contaminated soil, allowing the moisture and organic compounds to vaporize and escape from the soil. After processing, the soil would be discharged from the kiln into a pug mill where it is moisturized by the addition of water to reduce dusting problems.

The combustion gas leaves the kiln at about 300 to 400^{O}F and contains vaporized organic compounds and extrained soil particles. The combustion gas would pass through a cyclone, a baghouse, a wet scrubber, and a bed of granular activated carbon. The cyclone and baghouse remove the soil particulates. The wet scrubber removes acid gases, and the carbon bed removes any remaining organic compounds. Stack emissions would be monitored to verify compliance with federal and state regulations, including those for volatile organic compounds, hydrochloric acid (HCl), carbon monoxide (CO) and particulate loading.

The system requires an area of about 100 feet by 100 feet. The equipment is assembled on seven trailers for easy transportation. The soil would be processed at a rate of approximately 40 tons per hour (for soil with a moisture content of approximately 20 percent).

At an operating factor of about 80%, approximately 95 days of continuous operation would be required to treat 72,000 tons (45,000 cubic yards) of soil. Mobilization, demobilization and decontamination of the low temperature desorption equipment will take about 30 days. Therefore, implementation of on-site low temperature thermal desorption is expected to take less than one year.

Site Preparation and Preprocessing

Prior to excavation, the site would be cleared of vegetation. Any existing foundations or concrete pads would be decontaminated and disposed accordingly. Excavation and treatment will progress in stages. The excavation rate should match the treatment rate in order to minimize the storage space required. Water spray would be used for dust control, if necessary. Vapor suppression foams would be used if high levels of organic vapors in the breathing zone are detected during excavation. The excavated soil would be preprocessed in a tent structure of pole-barn construction and placed in containers or tanks. The storage space should be sized for adequate processing capacity to assure continuous operation during inclement weather.

The soil would be removed from the storage area in the tent using a covered belt conveying system and would drop into a hopper over a scalping screen or shredder to remove oversized (greater than 2-inch) material and debris. The sorted material would then be transported by an enclosed drag conveyor to a hopper that directly feeds the low temperature thermal desorption unit.

Rocks and other large objects would be screened and removed from the feed system, stockpiled on a pad, decontaminated by steam cleaning. These materials would then be used as backfill on-site, after confirmatory sampling to assure adequate decontamination.

Residuals Treatment

The water from the wet scrubber would be treated with a two-stage carbon adsorption system, and then used for ash quenching. Spent carbon from the system would be sent to an off-site hazardous waste incinerator for disposal. Soil particles from the cyclone and baghouse would be mixed with the treated soil from the thermal adsorber after analytical testing verifies the absence of organic compounds and metals. The excavated area would be backfilled with the treated soil. The treated soil would be analyzed for organic compounds prior to backfilling. If treated soil contains organic compounds above the clean-up criteria, then these soils would be recycled back into the treatment unit. The treated soils would also be analyzed for TCLP metals. If the treated soils fail to meet these criteria, the soils would be stabilized prior to backfilling. The treated soil would have sufficient properties to allow for standard grading and compaction equipment for backfilling operations. The area would be graded to match with existing drainage, covered with one foot of topsoil, and revegetated to minimize erosion.

8.8.2 Short-Term Effectiveness

Potential risks to public health and the environment are associated with the excavation and treatment of the contaminated soils.

Air pollution control systems will be an integral part of the low temperature thermal desorption system to limit air emissions to within the regulatory requirements. Stack and site perimeter monitoring will ensure that the discharge limits are not exceeded. An air dispersion model was used to calculate the ambient air quality resulting from the anticipated thermal desorption air emissions (after treatment with air pollution control systems). The air dispersion modeling was conducted in accordance with applicable EPA guidance documents. Based on the results of the air dispersion model, a health evaluation was conducted to determine the potential risk, if any, to public health from the inhalation of emitted compounds. The air dispersion model results (including associated input data calculations) and the health evaluations are presented in

Appendix G of the revised draft Feasibility Study Report. The air dispersion modeling for this alternative identified the downwind location where the maximum one-hour concentrations would be expected and the location where the maximum annual concentrations would be expected. The ambient air concentrations for the chemicals of concern at these locations determined by the air dispersion model were used to determine the potential risk, if any, to public health from the inhalation of emitted compounds generated by the thermal desorption process.

The public health evaluation identified the following potential receptor groups which may experience maximum exposures to airborne contaminants;

1. Remediation workers in the immediate vicinity of the thermal adsorber who might be exposed to short-term (one hour) peak concentrations;

2. Remediation workers present at the site for the duration of the remedial action (100 days) who might be exposed to airborne contaminants; and

3. Off-site residents who might be exposed to airborne contaminants for the duration of the remedial action (100 days).

For the first receptor group (remediation workers exposed for one hour to peak concentrations) the maximum predicted one-hour concentrations for each chemical of concern were compared to the Threshold Limit Values for those chemicals. Threshold Limit Values have been developed by the American Conference of Governmental and Industrial Hygienists (ACGIH) and are occupational exposure criteria that represent airborne concentrations of substances to which nearly all workers may be repeatedly exposed to without adverse effects.

The maximum predicted one-hour concentrations are far below the Threshold Limit Values for occupational exposure, therefore, it is concluded that there is no danger of acute toxicity due to exposure to short-term emissions from the thermal desorption unit.

For the second receptor group (remediation workers present at the site for the duration of the remedial action), the total cancer risk associated with exposure to maximum concentrations of all the chemicals of concern is estimated at 4.3×10^{-7} under the conditions of this scenario presented in Appendix F of the revised draft Feasibility Study Report. The total hazard index for non-carcinogenic effects is 9.1×10^{-4} which is far below the 1.0 hazard index value which indicates a potential hazard.

To represent the third receptor group (off-site residents who might be exposed for the duration of the remedial action), a child was used because of higher inhalation rate to body weight ratio, thus resulting in a worst case exposed scenario. For this receptor group, the total estimated cancer risk associated with exposure to maximum concentrations of all the chemical of concern is 5.7 X 10^{-7}. The total hazard index for non-carcinogenic effects is 1.2 X 10^{-3} which is below the 1.0 hazard index value which indicates a potential hazard.

Short term emissions of dust and organic vapors may occur during the excavation and pretreatment activities. These emissions may be mitigated by the proper use of water sprays, foams, and vapor control techniques. Downwind air monitoring for organics will be used to detect any off-site air emissions.

In addition, risks to workers may occur because of contaminant volatilization during excavation, and at the processing and stockpile areas. Workers involved with the waste excavation and processing activities may also be exposed to the additional risks associated with dermal contact contaminated soils. Therefore, all workers would be required to wear appropriate protective equipment, as specified in the site specific health and safety plan.

Short term emissions of dust, and organic vapors, may occur during the excavation and pretreatment activities. These emissions would be mitigated by the proper use of water sprays, foams, and vapor control techniques. Downwind air monitoring for organic compounds will be used to detect any off-site air emissions.

8.8.3 Long-Term Effectiveness

Magnitude of Residual Risks:

The treated soil would be tested for organic compounds to ensure treatment below established clean-up levels is achieved. Since the extraction efficiency for volatile organics is expected to be high, treatment residuals are not expected to contain organic contaminants above the clean-up criteria. Treatability testing would be conducted during remedial design to determine the expected organic concentrations after treatment. Carbon used for vapor treatment would be disposed of off-site at a RCRA incineration and/or landfill facility or would be regenerated at an approved facility.

Adequacy and Reliability of Controls:

Data available from a vendor indicates a volatile organic removal rate of 99.9 percent or greater is achievable by low temperature thermal desorption. Therefore, it is expected that the clean-up levels can be achieved by this technology. The removal of volatile organics from the soil by low temperature thermal desorption followed by the carbon bed adsorption of the collected vapors is a permanent process.

The spent carbon or carbon regeneration waste would be disposed at a permitted RCRA incineration and/or landfill facility to ensure adequate management of the treatment residuals.

8.8.4 Reduction in Mobility, Toxicity, or Volume

This alternative provides the multiple benefit of reducing the toxicity and mobility of organic contaminants present in the soil. The treatment process is irreversible and the treated soil is expected to meet the soil remediation goals. The volume of treated soil may be less than was processed in the system.

8.8.5 Implementability

Technical Feasibility:

The low temperature thermal desorption process has been used in several projects to treat organic compounds in soil. The system is commercially available through several vendors as trailer mounted transportable systems. The thermal desorption process has been used at a number of CERCLA sites.

Administrative Feasibility:

Acquisition of regulatory permits may not be required, although documentation for meeting the technical permit requirements would be provided to EPA for approval prior to implementation of remedial activities. The thermal desorption process has been used at a number of CERCLA sites.

Currently, five vendors are known to own low temperature desorption process equipment. Therefore, treatment units are available that would have sufficient capacity to perform soils treatment at the site within a reasonable period of time. Advanced scheduling will be required to ensure that a low temperature thermal desorption unit is available.

8.8.6 Compliance With ARARs

Chemical Specific ARARs

This alternative is expected to meet the calculated clean-up criteria for soils. The site soils above the cleanup criteria would be excavated and treated by low temperature thermal desorption.

Action Specific ARARs

Action specific ARARs for this alternative apply to the excavation of contaminated soils, monitoring requirements, and operation of a thermal treatment unit.

Workers and worker activities that would occur during the implementation of this alternative must comply with the OSHA requirements for training, safety equipment and procedures, monitoring, recordkeeping, and reporting. In addition, the RCRA requirements for preparedness and prevention, contingency plans, and emergency procedures would also apply to this alternative. Compliance with the above mentioned ARARs would be achieved by following an EPA approved work plan and a site-specific health and safety plan.

The RCRA standards for permitting hazardous waste facilities including performance standards (40 CFR 264) would apply to the low temperature thermal desorption unit. To achieve compliance with these ARARs, the unit used would be designed, constructed, and operated in accordance with the provisions contained in the RCRA waste facility regulations.

This alternative will result in air emissions. The applicable requirements for air emissions would be the Prevention and Significant Deterioration (PSD) air emission provisions contained in 40 CFR 51 and the requirements contained in the South Carolina Pollution Control Act. It is anticipated that the treatment system will not exceed the PSD limits and will comply with South Carolina Pollution Control Act requirements for air emissions.

The action specific ARAR of the RCRA Land Disposal Restrictions would apply for the backfilling of treated soils at the Bluff Road site. The cleanup criteria in the ROD (Tables 3-3 and 3-3) are below the LDR treatment standards (and the applicable Toxicity Characteristic levels).

The activated carbon, which would contain elevated levels of organic compounds, would be transported and incinerated off-site. The RCRA and U.S. Department of Transportation requirements for the packaging and transportation of hazardous waste would be applicable. Compliance with these ARARs would be complied with by disposing of the carbon at an EPA permitted RCRA incineration facility.

8.8.7 Overall Protection of Human Health and the Environment

This alternative would remove the organic contaminants from the soil to meet the remedial objectives for soil. The toxicity, mobility, and volume of the contaminants present in the soil would be reduced. Protection of human health and the environment would be achieved by complying with the identified ARARs.

8.8.8 Costs

The capital costs associated with this alternative include site preparation, thermal treatment unit mobilization and demobilization, pilot testing, construction of support facilities, soil excavation and treatment, backfilling, revegetation, mobile laboratory, and environmental monitoring. Due to the short implementation period associated with this alternative the operational and maintenance costs for this alternative are incorporated in the capital costs. Therefore, a present worth analysis has not been performed for this alternative. The estimated cost of this alternative (based on 45,000 cubic yards of soil) is $18,250,000. A detailed breakdown of the estimated costs associated with this alternative are presented in the final draft Feasibility Study Report.

8.9. Soil Excavation and Off-Site Disposal

8.9.1. This alternative consists of excavating the site soils that are above the clean-up criteria and transporting the excavated soils to an off-site RCRA landfill for disposal. Prior to initiation of the remedial design for this alternative, supplementary soil sampling would be performed to adequately delineate the volume of soil present above the target clean-up levels. Approximately 16,000 to 45,000 cubic yards of soil is estimated to be above the clean-up criteria at the site.

Prior to excavation, the site would be cleared of vegetation. Any existing foundations or concrete pads would be decontaminated and disposed accordingly.

An equipment staging area would be constructed for equipment storage. In addition, a mobile analytical laboratory would be installed on-site and used to provide quick turn around on soil sample analyses to verify that the affected site soils have been adequately removed. Excavation at the site is expected to be routine and would be accomplished using conventional construction equipment. Excavated soil would be placed directly into lined 20 cubic yard capacity trucks. Trucks would be decontaminated prior to leaving the site. Disposal of the site soils would be accomplished at a RCRA landfill. Analytical testing of the soils with the Toxicity Characteristic Leaching Procedure (TCLP) will be required to determine if the soils can be disposed of untreated in a RCRA landfill in accordance with the RCRA Land Disposal Restrictions (40 CFR 268). The Land Disposal Restrictions go into effect for CERCLA soils in May, 1992. If the soil cannot be land disposed, then pretreatment of the soils (i.e. solidification/fixation) would be required.

The excavated areas would be backfilled with clean fill/backfill material. A one-foot layer of topsoil would also be installed. The site would be graded to promote drainage and would be revegetated.

8.9.2 Short-Term Effectiveness

Potential risks posed to the community and the environment from volatilized organics or dust would be mitigated by the use of water sprays and foam suppressants during the remedial action. In addition, downwind air sampling would be performed to monitor any off-site emissions of volatile organics.

A site-specific health and safety plan (including protective equipment and monitoring equipment to be used) would be prepared and adhered to during the remedial action to minimize risks posed to workers.

To reduce the potential risks to public health or the environment resulting from an accident during transportation of the soils, a traffic control plan including routing of trucks to avoid populated areas would be developed and followed.

8.9.3 Long-Term Effectiveness

Magnitude of Residual Risks

Upon removal and disposal of the site soils that are above the clean-up criteria, the soil remediation objective will be achieved. Therefore, the leaching potential of the site soils into the groundwater plume would be eliminated.

Adequacy of Controls

There would be no soils left at the site that have concentrations above the clean-up criteria, therefore monitoring of the backfill and remaining site soils is not necessary. The ground water plume would be monitored no matter which ground water remedial action is implemented.

Reliability of Controls

Disposal of the excavated soils at a RCRA landfill would effectively isolate the contaminants of concern presented in the soils. Monitoring programs required at RCRA landfills are designed to detect potential failures so that corrective actions can be undertaken to mitigate the threat of a release.

8.9.4 Reduction of Toxicity, Mobility, or Volume

If no treatment technology (i.e. stabilization to meet Land Ban requirements) is employed, there would be no reduction in toxicity or volume of the contaminants. However the mobility of the contaminants would be decreased by placing the soils in a RCRA landfill.

8.9.5 Implementability

Technical Feasibility

Excavation and transportation of contaminated soils are common construction activities, and are considered technically feasible. The removal and transport of the contaminated soils is limited by the removal/excavation rate and/or the rate at which the materials can be accepted at the RCRA landfill facility. A waste profile sheet and a statement certifying the material as nonreactive must be provided to the landfill facility before the waste can be accepted.

RCRA manifest requirements must be complied with for all wastes shipped off-site. Effective May 8, 1992, discarded commercial chemical product contaminated soil and debris are prohibited from land disposal without treatment if the soils contain contaminants above certain limits established in 40 CFR 268. Pretreatment of the soils may be necessary at the site or may be accomplished at the disposal facility. The Land Disposal Restriction regulations will significantly increase the cost of disposed soils by landfilling.

Administrative Feasibility

Implementation of this alternative may require coordination with municipalities to determine the appropriate transportation routes.

Numerous remedial action contractors and hazardous waste transporters are available for the excavation and transportation of the site soils. Coordination and advanced planning is required to ensure that capacity is available at a RCRA landfill.

8.9.6 Compliance with ARARs

Chemical Specific ARARs

Action specific ARARs for this alternative apply to the excavation of contaminated soils, monitoring requirements, and transportation and disposal requirements.

Workers and worker activities that would occur during the implementation of this alternative must comply with the OSHA requirements for training, safety equipment and procedures, monitoring, recordkeeping and reporting. Also, the RCRA requirements for preparedness and prevention, contingency plans, and emergency procedures would apply to this alternative. Compliance with the above mentioned ARARs would be achieved by following an EPA approved work plan and a site-specific health and safety plan.

The action specific ARARs for disposal of soils in a RCRA landfill resulting from a CERCLA remedial activity are the RCRA Land Disposal Restriction regulations in 40 CFR 268 (effective November 1990). The site soils would be analyzed for EP toxicity metals and TCLP parameters. If the soils are above the concentration limits acceptable for disposal in a RCRA landfill, then pretreatment of the soils to meet the land disposal regulations would be required to comply with this ARAR.

The RCRA and U.S. Department of Transportation requirements for the packaging and transportation of hazardous waste would be applicable to this alternative. Compliance with these ARARs would be achieved by utilizing a licensed hazardous waste transporter.

8.9.7 Overall Protection of Human Health and the Environment

The excavation of the site soils and subsequent disposal in a RCRA landfill would meet the soil remediation objectives. The mobility of the soil contaminants would be reduced by placement of the soils in a RCRA landfill. Protection of human health and the environment would be achieved by complying with the identified ARARs.

8.9.8 Cost

The capital costs associated with the alternative include site preparation, excavation, transportation and disposal costs, and site restoration. Because of the relatively short implementation period associated with this alternative, operational and maintenance costs are incorporated in the capital cost. Therefore, a present worth analysis has not been performed for this alternative. The established cost of this alternative (based on 45,000 cubic yards of soil) is $20,700,000. A detailed breakdown of the estimated costs associated with this alternative are presented in the final draft Feasibility Study Report.

8.10. Soil Excavation and Off-Site Thermal Treatment

8.10.1 Technical Description

This alternative consists of excavating the site soils that are above the clean-up criteria and transporting the excavated soils to an off-site RCRA incinerator for treatment and disposal. Prior to initiation of the remedial design for this alternative, supplementary soil sampling would be performed to adequately delineate the volume of soil present above the clean-up criteria. Approximately 16,000 to 45,000 cubic yards of soil is estimated to be above the clean-up criteria at the site.

Prior to excavation, the site would be cleared of vegetation. Any existing foundations or concrete pads would be decontaminated and disposed of accordingly. An equipment staging area would be constructed of equipment storage. In addition, a mobile analytical laboratory would be installed on-site and used to provide quick turn around on soil samples to verify that the affected site soils have been adequately removed.

Excavated soil would be placed directly into lined 20 cubic yard capacity trucks. Trucks would be decontaminated prior to leaving the site. Thermal treatment of the soil would be completed at a RCRA-permitted incineration facility. Treated soil would then be disposed of in a landfill (most incineration facilities have associated landfills for disposal of treated wastes).

The excavated areas would be backfilled with clean fill/backfill material. A one-foot layer of topsoil would also be installed. The site would be graded to promote drainage and would be revegetated.

8.10.2 Short-Term Effectiveness

Potential short-term risks to public health and the environment are associated with the excavation and handling of the contaminated soil. Potential risks to the public may result from inhalation of volatilized contaminants or fugitive dust during excavation and from accidents during transportation of excavated soil. The potential risks posed to the community and the environment from volatilized organics or dust would be mitigated by the use of water sprays and foam suppressants during the remedial action. In addition, downwind air sampling would be performed to monitor any off-site emissions of volatile organic compounds.

A site-specific health and safety plan (including protective equipment and monitoring equipment to be used) would be prepared and adhered to during the remedial action to minimize risks posed to workers.

To reduce the potential risks to public health or the environment resulting from an accident during transportation of the soils, a traffic control plan including routing of trucks to avoid populated areas would be developed and implemented.

8.10.3 Long-Term Effectiveness

Magnitude of Residual Risks

The soil remediation objectives will be achieved upon the excavation and disposal of the site soils that are above the target clean-up levels. Therefore, the leaching potential of the site soils into the ground water plume will be eliminated.

No soils will be left at the site that have concentrations above the clean-up criteria, therefore monitoring of the backfill and remaining site soils is not necessary. The ground water plume will be monitored no matter which source control remedial action is implemented.

Adequacy and Reliability of Controls

The off-site RCRA incineration and landfill facility should operate within its permit(s) requirements and comply with all applicable regulations. Monitoring programs required at RCRA landfills are designed to detect potential failures so that the necessary actions would be implemented to control the treatment residuals.

8.10.4 Reduction of Toxicity, Mobility, or Volume

Implementation of this alternative would reduce the toxicity, mobility, and volume of the contaminants present in the site soils. This reduction of toxicity, mobility, and volume is accomplished by the thermal destruction of organic contaminants.

8.10.5 Implementability

Technical Feasibility

Excavation and transportation of contaminated soils are common construction activities, and are considered technically feasible. The removal and transport of the contaminated soils is limited by the excavation rate and/or the rate at which the materials can be accepted at the RCRA incineration facility. RCRA hazardous waste requirements must be complied with for all wastes transported off-site.

The RCRA incinerator would be effective at destroying the organic compounds present in the soils. The landfill would reliably isolate the treated soils.

Administrative Feasibility

Implementation of this alternative may require coordination with municipalities to determine the appropriate transportation routes. Numerous remedial action contractors and hazardous waste transporters are available for the excavation and transportation of the site soils. Coordination and advanced planning is required to ensure that capacity is available at a RCRA incineration facility.

8.10.6 Compliance with ARARs

Chemical Specific ARARs

This alternative is expected to meet the calculated clean-up criteria for soils. The site soils above the cleanup criteria would be excavated and treated at a RCRA incineration facility.

Action Specific ARARs

Action specific ARARs for this alternative apply to the excavation of contaminated soils, monitoring requirements, and transportation, treatment and disposal requirements.

Workers and worker activities that would occur during the implementation of this alternative must comply with the OSHA requirements for training, safety, equipment and procedures, monitoring, recordkeeping and reporting. Also, the RCRA requirements for preparedness and prevention, contingency plans, and emergency procedures would apply to this alternative. Compliance with the above mentioned ARARs would be achieved by following an EPA approved work plan and a site-specific health and safety plan.

The action specific ARARs associated with the incineration and disposal of treated soils at a RCRA facility include the RCRA Standards for Owners/Operators of Permitted Hazardous Waste Facilities (40 CFR 264), the air emission standards contained in 40 CFR 60, and the Prevention of Significant Deterioration provisions of the Clean Air Act. A permitted RCRA incineration and disposal facility must comply with these action specific ARARs.

The RCRA and U.S. Department of Transportation requirements for the packaging and transportation of hazardous waste would be applicable to this alternative. Compliance with these ARARs would be achieved by utilizing a licensed hazardous waste transporter.

8.10.7 Overall Protection of Human Health and the Environment

The excavation of the site soils and subsequent incineration and disposal of the treated soils at a RCRA facility would meet the soil remedial action objectives. The toxicity, mobility and volume of the soil contaminants would be reduced. Protection of human health and the environment would be achieved by complying with the identified ARARs for this alternative.

8.10.8 Cost

The capital cost associated with this alternative include site preparation and restoration and the cost of soil excavation, transportation and incineration. Because of the relatively short implementation period associated with this alternative, operational and maintenance costs are incorporated in the capital cost. Therefore, a present worth analysis has not been performed for this alternative. The estimated cost of this alternative (based on 45,000 cubic yards of soil) is $100,100,000.00. A detailed breakdown of the estimated cost associated with this alternative are presented in the final draft Feasibility Study Report.

9.0 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

Overall Protection of Human Health and the Environment

Groundwater Treatment

Both air stripping (with carbon adsorption) of extracted groundwater and carbon adsorption of extracted groundwater would decrease the potential threat to current and future users of contaminated ground water at the site or downgradient of the site. Both alternatives would be implemented until ARARs are met in the aquifer. In addition, effluent from the treatment system will meet the appropriate criteria for the chosen discharge alternative.

Discharge Alternatives

All of the discharge alternatives considered would protect human health and the environment with the exception of discharging the effluent to Myers Creek. Preliminary estimates of the volume of water to be discharged indicate the sensitive wetlands surrounding Myers Creek would be flooded due to the discharge. This flooding would destroy the wetlands and perhaps cause other damage as well. In light of this, discharge to Myers Creek has been eliminated as an option.

Source Treatment

The goal at the site is to protect ground water at the site from further degradation from the source and thereby diminish the time required to remediate the contaminated aquifer. Incineration of the source, on or off-site, and excavation with off-site disposal would provide the best overall protection of human health and the environment at this site. On-site thermal desorption will meet the cleanup goals established for the site and will allow for the treatment of any residual contamination through solidification of the treated soil. In-situ soil vacuum extraction has shown great potential as an effective remediation technique for soils contaminated with organic compounds. While it is unknown whether or not cleanup criteria for semivolatile organic compounds can be met, it is very probable that this technique may achieve all the cleanup criteria established for the soil contamination at the site. Overall, incineration would provide the most protection for human health and the environment, however, all of the alternatives will have the potential to meet the cleanup criteria for the contaminants identified for cleanup.

Compliance with ARARs

Groundwater Treatment and Discharge, Source Treatment

No alternative requires a separate ARAR waiver. All alternatives requiring excavation and treatment may require a "Soil and Debris Treatibility Variance for Remedial Actions". EPA regulations provide that treatability variances may be issued on a site-specific basis. 40 CFR 268.44(h). Thus, they may be approved simultaneously with the selection of a remedy in a CERCLA response action in the ROD. All other remedial alternatives (excluding no-action) are expected to meet ARARs.

Long-term effectiveness and permanence

Ground water treatment and discharge

Carbon adsorption and air stripping both provide long-term effectiveness and permanent solutions for ground water treatment.

Long-term effectiveness of the discharged treated water is best provided by reinjection or spray irrigation back into the wetlands area. This would minimize the impact on the wetlands over the long term.

Source treatment

Soil vacuum extraction provides for removal of the volatile fraction of the contaminants in soil. The long-term effectiveness is unknown, however, it has been established that soil vacuum extraction removes large quantities of contaminants and would therefore provide a permanent solution. Thermal desorption provides for long-term effectiveness and permanence since the organic contaminants are removed from the soil and, if necessary, remaining contaminants are solidified. On-site incineration or excavation and off-site treatment/disposal would also provide long-term effectiveness and permanence.

Reduction of mobility, toxicity, or volume

Air stripping increases the mobility of the contaminants after their extraction, allowing it to be captured through the carbon adsorption phase of treatment and as part of the emission controls. Carbon adsorption reduces the mobility of contaminants by capturing it in the treatment process.

Source treatment

Incineration destroys the contaminants, thereby eliminating toxicity and mobility, and reducing volume. Soil vacuum extraction and thermal desorption do not affect toxicity in and of themselves, however the treatment of the removed contaminants effectively destroy the contaminants. They both increase mobility by transferring contaminants to the air, thereby reducing their volume in the soil. Mobility of the contaminants in air for all the alternatives can be controlled by requiring strict emission control procedures as part of the remedy. Off-site disposal of wastes does not affect the inherent toxicity, mobility, or volume of the waste.

<u>Short-term effectiveness</u>

Ground water treatment and discharge

Both air stripping and carbon adsorption may have the following short-term effects:

risks to workers from exposure to drilling fluids and soil during the installation of the ground water extraction wells.

risks to workers and environment from release of contaminated water because of accidental spillage.

risks to workers, environment and nearby members of the public from uncontrolled emissions.

The Remedial Design will include all necessary measures to minimize potential adverse short-term effects on public health or the environment.

Source treatment

All alternatives with the exception of in-situ soil vacuum extraction require excavation of contaminated soils and have short-term impacts on the environment due to the release of organic contaminants (VOCs) into the air. Soil vacuum extraction, thermal desorption and incineration may have short-term impacts due to emissions from the various systems.

Off-site disposal of contaminated soils or off-site incineration of these wastes involve transportation of the waste, increasing short-term risk to populations along the transport route.

Implementability

Groundwater treatment and discharge

Air stripping and carbon adsorption are both proven technologies. Treatment systems and vendors are readily available and no impediment to implementation of either alternative is foreseen.

Discharge to the Congaree river, two to three miles away, would be difficult to achieve and to maintain over the time estimated to complete the groundwater treatment. Spray irrigation and injection into the subsurface are both implementable at the site.

Source Treatment

Soil vacuum extraction is a relatively new technology, but it is expected to be fully implementable. This technology is expected to be the most easily implemented due to a minimal necessity for intrusive activities. Additionally, very few materials handling difficulties are anticipated. Incineration is a proven technology. On-site incineration often invokes a negative reaction from local citizens. On-site thermal desorption and incineration are subject to substantive but not to administrative requirements, and are fully implementable. Excavation and off-site incineration may be difficult to implement due to availability of incinerator capacity in South Carolina. Off-site disposal of the contaminated soil is implementable.

Cost-Effectiveness

In-situ soil vacuum extraction is the most cost-effective remedy. All cost estimates for remedies involving excavation in the Feasibility Study Report are based on an estimated 45,000 cubic yards of soil to be remediated. This estimate is very high. An independent calculation of the volume of soil contaminated at concentrations greater than the cleanup criteria resulted in an estimate of approximately 23,000 cubic yards. This independent estimate was prepared by RAI, the EPA oversight contractor. The actual costs for all remedies requiring excavation and treatment would be lower than given in the Feasibility Study for less volume. Detailed estimated costs (based on 45,000 cubic yards of soil) are as follows:

Groundwater treatment

No Action Alternative	$ .76M
Carbon Adsorption	$ 16.10M
Air Stripping	$ 4.34M
Discharge Alternatives	
Subsurface Infiltration	$ .16M
Myers Creek	$ .42M
Surface Irrigation	$ .45M
Congaree River Discharge	$ 3.32M
Source Treatments	
In-situ Soil Vacuum Extraction	$ 1.07M
On-site incineration with stabilization of treated soils	$ 28.26M
On-site thermal desorption with stabilization of treated soils	$ 18.25M
Off-site Disposal of contaminated soils	$ 20.70M
Off-site Thermal Treatment of contaminated soils	$100.10M

The Carbon Adsorption alternative provides the same benefit as the Air Stripping alternative yet costs a great deal more.

Therefore, the Air Stripping Alternative is the most cost-effective alternative for treatment of the contaminated groundwater at the site.

Reinjection of groundwater is the least expensive of the discharge alternatives. This alternative will also help mitigate any potential impacts to the surrounding wetlands. Subsurface injection of the treated water is a cost-effective alternative.

Soil vacuum extraction is the most cost-effective alternative, assuming all ARARs can be met. The benefits provided by the other alternatives as compared to this in-situ alternative do not justify additional expenditure. The in-situ soil vacuum extraction alternative is more cost-effective than the other alternatives primarily because it provides an equal benefit for less cost. Long-term effectiveness, permanence, and protectiveness are achieved, and reduction of toxicity, mobility and volume is achieved.

State Acceptance

The State of South Carolina has indicated verbally that they concur with the selected remedy. All the excavation and treatment alternatives are acceptable to the State if they include treatment of residual metals contamination. The State has stipulated that they will not concur with a ROD unless given assurances that an additional groundwater investigation is conducted. Additional groundwater studies, including the installation of a minimum of two deep wells, will be necessary during the Remedial Design development to further define the contamination.

Community Acceptance

The public meeting was well-attended. Local citizens voiced concerns over the Agency's timetable and urged rapid action at the site. Written comments were received from the Bluff Road Group, representatives of a local citizen's group and from the South Carolina Department of Health and Environmental Control. The latter comments are described under "State Acceptance". The private citizens voiced a preference for off-site incineration. It is likely the Agency's chosen alternative will be readily accepted by the public. A more detailed response to all comments received during the public comment period is provided in the responsiveness summary.

10.0 SELECTED REMEDY

The remedy selected for this site is:

extraction and on-site treatment by air stripping of contaminated ground water at the site

in-site soil vacuum extraction of contaminated soils at the site

monitoring

subsurface injection of treated water

This remedy will attain a 10^{-6} cancer risk level as it removes the source of the groundwater contamination as well as the contaminated groundwater.

10.1 Description of Recommended Alternative

Groundwater treatment and discharge

This alternative consists of a combination of ground water extraction and ground water treatment. Contaminated ground water would be extracted from the upper aquifer by installing recovery wells. Ground water treatment would be accomplished by means of air stripping towers, followed by a granular activated carbon (GAC) system. The more volatile constituents in ground water would be removed by air stripping, while semi-volatiles would be removed by the GAC system. A pretreatment process, such as precipitation or flocculation, may be necessary to remove metals from the ground water prior to treatment by air stripping and GAC. The need for any such pretreatment process would be evaluated as part of the remedial design activities.

The ground water extraction system would consist of a combination of recovery wells located within the contaminant plume, and at the periphery of the plume. Recovery wells would be placed in the more highly contaminated zone of the plume to facilitate rapid removal of organics. The periphery wells would be used to limit expansion of the plume.

The extraction system including number, location, and configuration of wells would be developed during the remedial design. Pump tests and ground water modeling would be required for the design of the extraction system. For the purpose of this analysis, four extraction wells and a total flow of 100 gpm were used. The pumping rate is a conservative value based on data from the RI.

The ground water from the extraction wells would be pumped into a surge tank before it is fed to the air stripping system. The air stripping system would consist of two towers arranged in series. Both towers would have 12 feet of packing material, 30 inches in diameter and use high air-to-water ratios.

Prior to treatment, the extracted ground water would contain the compounds identified in Tables 1 and 2 at the measured maximum concentration shown in column 1. Contaminant concentrations should steadily decrease from these levels. Actual treatment system influent composition would be defined during remedial design.

Air stripping can effectively remove most of the contaminants found in ground water at the Bluff Road Site (Golder, 1986). The exceptions would be 2-chlorophenol and phenols which would be removed by adsorption on the GAC.

After air stripping, the ground water would be pumped through cartridge filters and two carbon beds, also arranged in series. When the carbon in the first bed is spent, it would be replaced. A valve on the adsorption system would then be switched to reverse the order of the beds in the series. The beds are sized so that carbon would be expected to be replaced every 4 to 6 weeks. The system would be automated and designed for unattended operation. The final design of the ground water extraction system, air stripper, and GAC systems would require additional data collection prior to design.

As a result of ground water extraction and treatment, a discharge stream of treated ground water would be generated. As a best engineering judgement based on available data, the volumetric flow of the discharge stream is assumed to be 144,000 gallons per day based on 100 gpm ground water recovery system operating 24 hours per day. More precise ground water withdrawal and discharge values would be determined as part of the remedial design.

Infiltration galleries are a proven and viable alternative for effluent discharge. The process involves the use of drains, trenches and/or piping to introduce the treated ground water into the vadose zone where it is allowed to percolate into the soil. There are two basic types of infiltration galleries, horizontal and vertical. The horizontal system uses trenches lined with gravel or perforated piping to introduce the ground water into the vadose zone. Vertical infiltration uses vertical perforated piping with appropriate packing materials to allow radial infiltration over the depth of the vadose zone.

Discharge limitations for subsurface infiltration of the treated ground water will be the cleanup criteria. This effluent discharge option would establish the discharge design requirements for the ground water treatment system.

The effectiveness of this method is dependent on vadose zone acceptance of the treated water. A preliminary assessment of infiltration rates based on aquifer and near aquifer vadose zone soil classification indicates that this technology would be feasible for the Bluff Road Site.

Percolation testing must be performed to determine permissible application rates of treated ground water and to establish the most appropriate process alternative (i.e., horizontal or vertical). The infiltration gallery must be located so that recharge to the aquifer does not interfere with the performance of the extraction system (hydraulic control). These considerations can be addressed adequately in design. The basis for conceptual cost evaluation is a horizontal infiltration gallery. The estimated infiltration area required was determined using the lowest permeability determined by performing slug tests on shallow wells in the upper aquifer (9.27×10^{-4} cm/sec). This equates to an estimated permissible application rate of 50 gallons/day/ft^2. With an estimated flow rate of 100 gpm, approximately 3000 ft. of infiltration trenches would be required for horizontal infiltration. The infiltration trenches would be distributed over an area of approximately 15,000 square feet. This is based on a trench width of approximately 2 feet and trench spacing of approximately 7.5 feet (center to center). Again, permissible application rates would have to be confirmed during remedial design.

Source Remediation

The vacuum extraction system would consist of air vacuum wells installed in the unsaturated zone. A pump and manifold system of PVC pipes will be used for applying a vacuum on the air wells which feed an in-line water removal system, and an in-line vapor phase carbon adsorption system for VOC removal. Once the well system has been installed and the vacuum becomes fully established in the soil column, VOCs are drawn out of the soil and through the vacuum wells. This treatment technology has been proven effective at treating soils that contain elevated levels of organic contaminants. Prior to initiation of this remedial alternative, supplementary soil sampling would be performed to adequately delineate the aerial extent of the necessary vacuum influence areas.

<u>Process Description</u>

Soil vacuum extraction as proposed herein is an in-situ treatment process used to clean up soils that contain volatile and some semi-volatile organic compounds. The process utilizes extraction wells to induce a vacuum on subsurface soils. The subsurface vacuum propagates laterally, causing in-situ volatilization of compounds that are adsorbed to soils. Vaporized compounds and subsurface air migrate rapidly to extraction wells, essentially air stripping the soils in-place.

A vacuum extraction system consists of a network of air withdrawal (or vacuum) wells installed in the unsaturated zone.

A pump and manifold system of PVC pipes is used for applying a vacuum on the air wells which feed an in-line water removal system, and an in-line vapor phase carbon adsorption system for VOC removal. Vacuum wells can be installed vertically to the full depth of the contaminated unsaturated zone. Vertical wells were selected due to the depth of the soil strata requiring remediation, geotechnical conditions, and the depth to groundwater.

Once the well system has been installed and the vacuum becomes fully established in the soil column, VOCs would be drawn out of the soil and through the vacuum wells. In all soil vacuum extraction operations, the daily VOC removal rates eventually decrease as volatiles are recovered from the soil. This occurs since volatile recovery decreases the VOC concentration in the soil, and consequently reduces the diffusion rate of volatiles from the soil. Volatiles in the air stream are removed by the carbon adsorption system or destroyed by fume incineration, after which the cleaned air is discharged to the atmosphere.

The application of soil vacuum extraction to the unsaturated zone remediation is a multi-step process. Specifically, full-scale vacuum extraction systems are designed with the aid of laboratory and pilot-scale VOC stripping tests. Further testing would be performed as part of remedial design.

10.2 Cost of Recommended Alternative

Groundwater Treatment and discharge

The present worth cost of the Air Stripping alternative would be approximately $4,339,500. This cost would include a capital cost of $1,012,000 for construction of The groundwater extraction system, the treatment units, a treated water discharge system, and all associated piping. This cost also includes annual expenditures for operation and upkeep of the system of $306,875. The total of the annual costs over 16 years, using a 5% discount rate is $3,326,500.

The present worth cost of the infiltration gallery/reinjection discharge alternative is approximately $165,484.

The estimated total cost for the soil vacuum extraction system with vapor phase carbon adsorption would be approximately $1,070,000. This capital cost includes the anticipated O&M expenditures since this remedial action is not expected to last over 2 years.

Capital cost would include construction of the soil vapor extraction system, vapor treatment system, and all associated piping/mechanical facilities.

The total present worth cost for the remedial action is $5,574,984 based on the information in the Feasibility Study Report. A detailed cost breakdown for each alternative and the selected remedy is given in the tables at the end of Chapter 5 in the Feasibility Study Report.

10.3 Schedule

The Remedial Design is to begin in the winter/spring of 1991 and be completed no later than one year later. Construction of the Remedial Action should begin in January 1992.

10.4 Future Actions

After groundwater remediation shutdown, a post closure groundwater monitoring program is to be initiated to determine the permanence of remediation. No other remedial actions, other than those described herein, are anticipated in the future at this site. The selected remedy addresses all known areas of contamination at the site.

11.0 STATUTORY DETERMINATIONS

The selected remedy satisfies the requirements of Section 121 of CERCLA.

Protection of Human Health and the Environment

The selected remedy will permanently treat the groundwater and soil and removes or minimizes the potential risks associated with the wastes. Dermal, ingestion, and inhalation contact with site contaminants would be eliminated, and risks posed by continued groundwater contamination would be reduced.

Attainment of ARARs

This alternative will comply with ARARs.

This alternative will comply with the substantive technical requirements of the Clean Air Act 40 CFR Part 50 concerning particulates and volatile organic emissions during excavation.

Cost-Effectiveness

The groundwater and source remediation technologies are more cost-effective than the other alternatives considered primarily because they provide greater benefit for the cost.

Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable

The recommended alternative represents the maximum extent to which permanent solutions and treatment can be practicably utilized for this action.

Preference for Treatment as a Principal Element

The preference for treatment is satisfied by the use of a vacuum extraction system to remove contamination from soil at the site and the use of air stripping to treat contaminated ground water at the site. The principal threats at the site will be mitigated by use of these treatment technologies.